

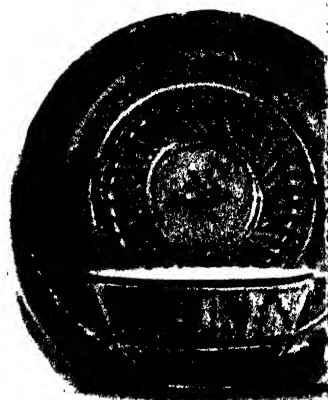
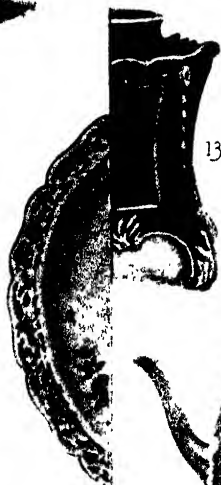
THE
NEW GRESHAM
ENCYCLOPEDIA
VOLUME IX

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VOLUME IX



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KEY TO PRONUNCIATION

The method of marking pronunciations here employed is either (1) by marking the syllable on which the accent falls, or (2) by a simple system of transliteration, to which the following is the Key:—

VOWELS

ā, as in <i>fate</i> , or in <i>bare</i> .	eu, a long sound as in Fr. <i>jeûne</i> =Ger. long <i>ö</i> , as in <i>Söhne</i> , <i>Goethe</i> (Goethe).
ä, as in <i>alms</i> , Fr. <i>âme</i> , Ger. <i>Bahn</i> =á of Indian names.	eu, corresponding sound short or medium, as in Fr. <i>peu</i> =Ger. <i>ö</i> short.
â, the same sound short or medium, as in Fr. <i>bal</i> , Ger. <i>Mann</i> .	ō, as in <i>note</i> , <i>moan</i> .
a, as in <i>fat</i> .	o, as in <i>not</i> , <i>soft</i> —that is, short or medium.
â, as in <i>fall</i> .	ō, as in <i>move</i> , <i>two</i> .
a, obscure, as in <i>rural</i> , similar to u in <i>but</i> , é in <i>her</i> : common in Indian names.	ū, as in <i>tube</i> .
ē, as in <i>me</i> =i in <i>machine</i> .	u, as in <i>tub</i> : similar to é and also to a.
e, as in <i>met</i> .	ū, as in <i>bull</i> .
é, as in <i>her</i> .	ü, as in Sc. <i>abune</i> =Fr. <i>û</i> as in <i>dû</i> , Ger. <i>ü</i> long as in <i>grün</i> , <i>Bühne</i> .
i, as in <i>pine</i> , or as <i>ei</i> in Ger. <i>mein</i> .	û, the corresponding short or medium sound, as in Fr. <i>but</i> , Ger. <i>Müller</i> .
i, as in <i>pin</i> , also used for the short sound corresponding to ē, as in French and Italian words.	oi, as in <i>oil</i> .
	ou, as in <i>pound</i> ; or as <i>au</i> in Ger. <i>Haus</i> .

CONSONANTS

Of the *consonants*, **b, d, f, h, j, k, l, m, n, ng, p, sh, t, v, z**, always have their common English sounds, when used to transliterate foreign words. The letter **c** is not used by itself in re-writing for pronunciation, **s** or **k** being used instead. The only consonantal symbols, therefore, that require explanation are the following:—

ch is always as in <i>rich</i> .	s, always as in <i>so</i> .
d, nearly as <i>th</i> in <i>this</i> =Sp. <i>d</i> in <i>Madrid</i> , &c.	th, as <i>th</i> in <i>thin</i> .
g is always hard, as in <i>go</i> .	th, as <i>th</i> in <i>this</i> .
h represents the guttural in Scotch <i>loch</i> , Ger. <i>nach</i> , also other similar gutturals.	w always consonantal, as in <i>we</i> .
ñ. Fr. nasal <i>n</i> as in <i>bon</i> .	x=ks, which are used instead.
r represents both English <i>r</i> , and <i>r</i> in foreign words, which is generally much more strongly trilled.	y always consonantal, as in <i>yea</i> (Fr. <i>ligne</i> would be re-written <i>lêny</i>).
	zh, as <i>s</i> in <i>pleasure</i> =Fr. <i>j</i> .

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VOLUME IX

Photo-chemistry, that branch of general chemistry which deals with the relations of chemical action and of chemical constitution to light, or, more generally, to all electromagnetic radiation, including ultra-violet rays and X-rays. The effects of chemical constitution on optical phenomena are discussed in the articles *Colour*, *Dispersion*, *Fluorescence*, *Light*, *Phosphorescence*, *Polarization of Light*, *Refraction*, *Saccharimeter*, *Spectrum*, and *Spectroscopy*. There are many well-known examples of the influence of light on chemical action, such as the combination of hydrogen and chlorine to form hydrochloric acid when exposed to sunlight. But the most important instances of photo-chemical action occur in the processes of photography (q.v.) and in photo-synthesis, the process by which plants use the energy of sunlight to assimilate carbon from the atmosphere. See *Carbon Assimilation*; *Photography*; *Physical Chemistry*.

Photo-electric Effect, an electrical action produced by light. The term is sometimes applied to each of the following actions, but is more often confined to the first: (1) an emission of electrons from solids; (2) an increase in the electrical conductivity of certain badly conducting solids; (3) an E.M.F. between an illuminated and a non-illuminated electrode immersed in certain liquids.

(1) This action, first clearly described by Hallwachs (1888), is of great theoretical importance (see *Quantum Theory*); it is now known to be essentially similar to the emission of secondary β -radiation under the action of X-rays. It occurs in all substances illuminated by light of suitable frequency, but is most easily studied in metals. The electrons emerge in all directions from the illuminated surface with all velocities up to a certain maximum. If V is the potential difference through which an electron bearing a charge e has to fall in order to acquire this maximum velocity, then V is given by Einstein's equation $e(V + V_0) = h\nu$, where ν is the fre-

quency of the incident light, h is Planck's constant (see *Quantum Theory*), and V_0 a constant characteristic of the illuminated surface. V_0 is less for the more electropositive metal, and the difference between V_0 for any two metals is equal to the contact potential or Volta effect (q.v.) between them; but V_0 is greatly affected (usually increased) by the presence of gas films and other impurities on the surface. If $h\nu$ is less than eV_0 , no electrons are emitted; consequently there is a minimum frequency for each metal below which light will not cause this photo-electric effect. The alkali metals (except lithium) respond to visible light; the common metals only to ultra-violet light.

The conditions determining the number of electrons emitted (and thus the current flowing) are more complex. The number is proportional, *ceteris paribus*, to the light absorbed at the surface; its ratio to the light energy absorbed increases in general with ν and decreases as V_0 increases. But the alkali metals show a selective effect, in addition to this normal effect, which rises to a sharp maximum for a particular value of ν . The selective effect is produced only by the component of the light polarized with the electric vector in the plane of incidence; the normal effect is independent of polarization.

Both effects can be greatly increased in the alkali metals by converting the surface into a colloidal modification by making it the kathode of a discharge through hydrogen at a low pressure. Photo-electric cells, with surfaces of potassium or rubidium sensitized in this manner (erroneously called hydride cells), are used in the measurement of feeble light; they are rather more sensitive than the eye in detecting feebly illuminated surfaces.

(2) is particularly associated with selenium (q.v.), and is also employed practically. (3) is characteristic of fluorescent solutions, but has only been studied recently. Both (2) and (3) are probably fundamentally the same in nature.

as (1).—BIBLIOGRAPHY: A. L. Hughes, *Photo-electricity*; H. S. Allen, *Photo-electricity*.

Photogrammetry, a method of surveying by means of photography. The angular distance subtended by any two objects which appear upon a photograph, at the position occupied by the optical centre of the lens (see *Optics*; *Lens*) during exposure, can be calculated. Thus, if we consider the photographic plate to be held vertical, and the optical axis of the camera lens to be horizontal, we may consider the plate as a tangent to a horizontal arc whose radius is the focal length and whose centre is the optical centre of the lens. The camera becomes in this way a substitute for theodolites or plane tables, and rays may be drawn from the known position of the camera to all points whose images appear on the plate. If two known positions are occupied by the camera, then the positions of any point or feature which appears on both photographs may be fixed by the intersection of rays, providing that the orientation of the camera is known in each case.

It is easy to ascertain the positions of a few clearly defined objects in this way and with sufficient accuracy for medium and small scale surveys, but it is very difficult to ensure that the whole area to be mapped is included upon at least two plates, and it is equally difficult to recognize badly defined points from their images on different plates. Photogrammetric surveys on vertical plates are generally confined, therefore, to areas such as the Alps, the Rockies, and the Himalaya, where the outline is sharp and distinctive.

The camera need not, theoretically, be held vertical, for, so long as the position of the camera, its orientation, and the angle of inclination are known, plotting may be carried out, but with so much added difficulty that in practice all surveying cameras or 'photo-theodolites' for use from ground stations are intended to be carefully levelled.

Since the development of dirigible air-craft, photogrammetry has been applied to photographs taken from the air. In its most favourable case, where the plane of the plate is parallel to the plane of the map, and the ground itself is flat, the resulting photograph becomes a plan, whose scale is governed by the height of exposure and the principal distance of the camera. Such photographs are rarely obtainable in practice, for lack of any means of maintaining the camera in a fixed position relative to the earth, and because the earth is not generally flat.

Providing, however, the pilot is trained to fly straight and level, that there are numerous control-points whose images can be seen on the photographs, and that the ground is not markedly hilly, fairly good small-scale maps may

be made on the assumption that the planes are parallel.

For more accurate mapping from air photographs each point must be plotted separately. This can be done from individual photographs, providing that the ground is flat, or by the intersection of rays from two or more photographs if the ground be markedly uneven, but in either case the position of four control-points must appear on each photograph.

Photogrammetry on vertical, horizontal, or inclined plates has had little commercial development, but may be of value to large national surveys for use in conjunction with other methods.

A remarkable development of photographic surveying is stereophotogrammetry. The human power of judging distance is principally due to the divergence of rays from an object to the pupils of the eye, or, in other words, to the angle subtended at the object by the eyebase. This stereoscopic effect can be magnified optically both by enlarging the eyebase and by magnifying the object. In stereophotogrammetry distance is judged not on the ground, but on two photographic plates taken in the same vertical plane at the ends of a short measured base.

Several types of stereoscopic microscope or comparator have been made, but the Zeiss comparator, designed by Professor Pulfrich of Jena, is the best and most complete. By its aid the bearing, distance, and height of all objects common to both photographs may be measured relatively to one end of the base.

At this stage of its development stereophotogrammetry has this great advantage over simple photogrammetry: that the difficulties of the identification of points on two separate plates are eliminated, and even, flattish country can be mapped without difficulty.

A further development, the stereoautograph, invented by Captain von Orel, makes it possible to plot automatically and without calculation from the comparator. Thus, contours may be traced direct in addition to detail which can be actually seen. Were it not for the difficulty and expense of procuring these instruments, stereophotogrammetry would already have gone far to replace other methods of surveying at medium scales and for engineering purposes. See *Surveying*; *Photography*.

Photography. The word *photography* was first used by Sir John Herschel in 1840. It signifies a drawing made by light (Gr. *phos*, light, and *grapho*, I write). There are two main functions of photography: (1) the production of an image by the camera; (2) the fixation of that image by chemical means. Then there is the reproduction of any number of positives from the negative image obtained in the camera. The camera was invented 350 years before photo-

graphy, and it was, as its name implies, a chamber or room. This dark room was called a *camera obscura*, and there was practically no invention required, as any dark room with a small hole in the window-shutter would produce an inverted image of the sun-lit scene outside. Later there was invented the *camera lucida* (q.v.), the principle of which is shown in fig. 1. To the observer the image appears to be on the paper placed on the table, and he is able to make a drawing by tracing round it. It was the beauty of these camera images which suggested to several men that light itself might produce a permanent picture.

A German physician, Johann Heinrich Schulze, discovered that a mixture of chalk with a solution

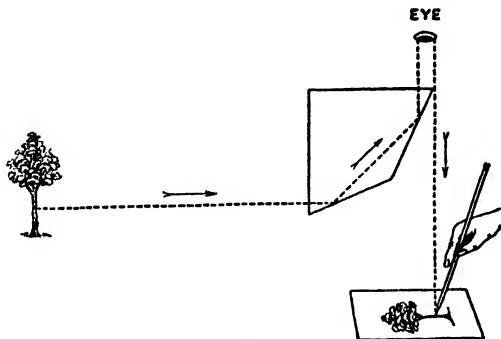


Fig. 1

of silver nitrate became blackened by sunlight. He cut out stencils of letters and words, and, placing these over the mixture, he succeeded in getting a black image of them. This was undoubtedly a case of writing or drawing by light. Dr. William Lewis, of Kingston-on-Thames, repeated Schulze's experiments in 1763, and made notes concerning them. On the death of Lewis in 1781 his notebooks were purchased by Josiah Wedgwood, the potter, who also took Lewis's assistant—Chisholm—into his employment, making him tutor to his son Tom. In 1790 we find young Tom Wedgwood making experiments with pieces of white paper and leather treated with silver nitrate, and with the agency of light he made faithful copies of transparent drawings. In 1802 Tom Wedgwood and Humphry Davy sent a paper to the Royal Institution (London) describing experiments with silver nitrate on paper, but with no means of fixing the image permanently. Wedgwood and Davy attempted to entrap the image of the camera obscura, but without success, although they succeeded with the more concentrated image of a solar microscope, which was practically a daylight magic lantern. Then followed William Henry Fox Talbot, a grandson of the Earl of

Iichester, who succeeded in obtaining a paper negative of Lacock Abbey, his country home, in 1835. He was led to this through failing to trace the images of the camera lucida. Talbot's experiments were undoubtedly an extension of the experiments which Wedgwood and Davy had made some thirty years earlier. In 1841 Talbot patented a new process, which he named *calotype* (signifying beautiful pictures), but the public christened it *talbotype* after its inventor. In this process he treated the paper with iodide of silver, and, immediately before exposing it in the camera, he washed it over with a mixture of aceto-nitrate and gallo-nitrate of silver. A great advance had been made in 1841 by the introduction of a portrait lens invented by Joseph Petzval, who was professor of mathematics in the University of Vienna. By using a larger aperture he was able to increase the illumination and consequently to reduce the time of exposure; the principle which he introduced is the same as used to-day. In 1840 Sir John Herschel introduced glass plates in place of paper negatives, but these had no supporting film. As already stated, it was Herschel who first used the word *photography*, the art having been known previously as *photogenic drawing*. It was not until 1848 that a supporting film was suggested by Nicpce de St. Victor, who was a nephew of Joseph Nicéphore Nicpce. The first supporting film was the white of an egg, this albumen being spread over the glass, and the silver salts being contained in it. In 1851 Frederick Scott Archer invented the wet collodion plate, and he introduced a method of converting the negatives into positives. The *tintype* photographs still taken at some English watering-places and at country fairs are descendants of the Scott Archer process. After the wet collodion plate there came the dry gelatine plate of Dr. R. L. Maddox in 1871, and by 1880 dry plates were being marketed in the United States by George Eastman.

The daguerreotype process, which was invented by Louis Jacques Daguerre, a scene-painter in Paris, was off the line along which photography has been evolved. The pictures which he produced on silvered plates were excellent, and did much to popularize the camera, but only indirectly did they take any part in the evolution of photography. Daguerreotype portraits were often tinted by hand, and the colour effects produced were sometimes very pleasing; but so early as 1861 there was established a three-colour process of photography by the distinguished physicist Clerk Maxwell, and this was modified by F. E. Ives in 1888. With the exception of two experimental methods, all colour photography is based upon Clerk Maxwell's three-colour process. Three negatives are taken

through red, green, and blue screens respectively, as in the Ives and Sanger-Shepherd processes; or all may be combined in one negative by taking the picture through a glass screen covered with coloured lines, red, green, and blue successively, as is done in the Joly process; or the negative itself may contain very fine starch grains dyed these three colours, through which the negative is taken and converted by chemical means into a transparent positive, so that it is viewed through the coloured starch grains as in the Lumière process.

In modern photographic processes we have to deal with the exposure of the sensitized surface, the production of the negative, and the preparation of positive prints. The time of exposure of the sensitized film or plate is dependent not only upon the amount of light available at the time of exposure, but also upon the particular kind of lens used; further, upon the amount of stopping down of the lens, and also upon the sensitivity of the chemically prepared surface.

There is great variety in the construction of photographic lenses, the production of which demands considerable mathematical knowledge. The simple uncorrected lens is still used by some photographers who do not care for definition, but the construction of modern lenses takes into account the fact that the focus of the chemical rays differs from that of the visual rays; the modern lens is *achromatic*.

Many small hand cameras are made with a fixed focus. A lens is generally described as being of a certain focus, working at a certain aperture, and covering a certain size of plate. The *focus* (strictly *focal length*) of a lens (q.v.) is the distance from the plate or ground-glass screen to the lens, when it is focused on an object at such a distance that everything beyond it is also in focus. We may focus some object so that its image on the screen is exactly the same size as the object; the lens will then be found to be the same distance from the image as it is from the object. If this distance measures 16 inches, the focus of the lens would be known as 8-inch. Then the desired aperture is obtained by stopping down the lens. The stops are never described by the diameter of the aperture, but by the relationship between that diameter and the focus of the lens. Therefore, when the stop has a diameter of 1 inch, and it is used with a lens having a focus of 8 inches, the stop would be called F/8, because the diameter of the stop would be one-eighth of the focus of the lens. This is a common relationship in modern lenses, the largest stop employed having a diameter one-eighth of the focus of the lens. The next size smaller is F/11·3 stop, which only admits one-half of the light of

an F/8 stop, so that it requires twice the time of exposure. The smaller stops are F/16, F/22·6, F/32, F/45, and F/64, but few lenses now go to a stop of F/64, though this was common for very fine definition with the old rapid rectilinear lenses. The general principle of an R.R. (rapid rectilinear) lens is shown in fig. 2.

An R.R. lens is a good all round one, but there are more modern lenses which cost more money, such as an *anastigmat*, which soon shows its superiority if employed at large apertures on subjects with fine details, and especially if used for copying flat objects.

All Kodak cameras have the stops marked on the U.S., or 'uniform system', which states

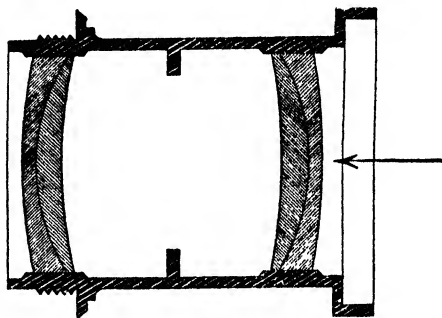


Fig. 2

F/4 as 1, and follows with F/5·6 as 2 (requiring twice the exposure of F/4); F/8 is marked 4 (four times the exposure of F/4), and so on, until F/64 is marked U.S. 256, with which stop 256 times the exposure of F/4 must be given. In both systems each succeeding stop requires twice the exposure of the preceding one. It is obvious that the object of the lens is to admit as much light as possible, and at the same time to focus the rays correctly. In pinhole photography, which dispenses with the lens, there is, of course, no particular focal length. If an object is desired to cover the greater part of the plate, the camera bellows may be extended, making the image larger and larger until the desired size is obtained, but the pinhole must be very small if the picture is to be sharp. It is usual to have a very small round hole drilled in a sheet of metal. The hole required for good work may measure from one fiftieth to one seventy-fifth of an inch. But for the fact that the pinhole admits so little light, necessitating a very long exposure, it would be used more often.

The sensitive coating which is to be affected by the light may be supported on glass or celluloid. Both of these are very much superior to the paper negatives of Fox Talbot, as paper is not easily made translucent, which is necessary

to obtain the reproductions of positives through the negatives. The glass negative has the advantage of rigidity, but the disadvantage of weight, which disadvantage, however, is discounted for some purposes by the fact that it costs very much less than celluloid; the roll-film on celluloid may cost three times as much as glass. The reason why the roll-film is so popular is the convenience of daylight loading of the camera and daylight development of the negative. These advantages, added to its light weight and small bulk, are a great asset, though it is possible to make more rapid glass plates than roll-films, and celluloid films will not keep as well as glass plates. Very rapid plates should not be used excepting where their speed is a necessity. Slower plates have a more opaque film, and they possess a greater range of exposure. Correct exposure is the key to successful photography. It used to be thought possible to remedy an incorrectly exposed plate in the process of development by compensating for over or under exposure, but this has been found to be a fallacy. A great deal of useful research on the subject of exposure was made by Dr. Hurter, an eminent chemist, and Mr. V. C. Driffield, an engineer, who collaborated with him. They found that most sensitized plates possessed a great deal of latitude as to correct exposure. For instance, when the time necessary for a perfect negative was obtained, it was found that an equally perfect negative might be obtained with twice, four, eight, or it might on occasion even be thirty-two, times as long. This latitude is dependent upon three factors: (1) the subject, (2) the nature of the sensitized film, and (3) the thickness of the coating. The thicker the plate is coated (up to a certain point) the greater is the latitude. Generally speaking, the slower the response of the chemically prepared surface the greater is the latitude in exposure. It will be clear that exposure is influenced by the following factors: (i) the rapidity of movement of the object, or of the camera itself if it is travelling; (ii) the amount of light available; (iii) the focus of the lens and its stopping down; (iv) the sensitiveness of the plate; (v) the nature of the subject itself. It is a difficult task to determine all these factors at the time of exposure. Tables for correct exposure have been published, but these were never of much value, and have been superseded by the researches of Hurter and Driffield. These investigations showed that the influence of the height of the sun was a perfectly definite one, and they obtained time curves of the changes in the power of daylight due to the height of the sun. These curves led to the invention of the *actinograph*, by which exposures may be estimated. The height of the sun is not the only factor, for the dust in the

atmosphere plays an important part; this is very noticeable in the red sunset. The results of the researches of Hurter and Driffield are embodied in the H. & D. numbers. Plates marked H. & D. 100 require only half of the exposure of these marked H. & D. 50. The only point which is really left to the judgment of the photographer is the nature of the subject itself. Yellow and red objects may require as much as twice the average exposure, and so on. We must, of course, take into account the distance of the most important part of the subject; the nearer it is to the camera the longer exposure will it require.

The sensitized coating of the photographic plate is of great interest and considerable mystery. We do not understand the nature of the latent image which we know is produced in the plate, and which is invisible until development. The sensitive surface of the plate or film consists of gelatine, throughout which there are distributed small particles of bromide of silver. The particle of silver bromide is composed of the two elementary substances—bromine and silver—in combination with each other. The compound substance has properties entirely different from the elements of which it is composed. The action of light falling upon this compound is to make it less stable. One cannot note any difference in its appearance, nor can one detect any chemical alteration, but there is no doubt that in some mysterious way the bombardment of the light has left the substance in a less stable condition, but a further bombardment of light renders it stable again; a still further attack of light renders it so unstable that the bromide and the silver part company. The developing solution takes away the bromine from the silver bromide particles which have been exposed to light, leaving the silver coating, but those particles which were sheltered by some dark part of the image remain unaffected. These unaffected salts must be removed by the fixing-bath, or they would still be susceptible to any further exposure to light. The developer consists of three reagents: (1) a developing agent, (2) an accelerator, (3) a retarder. These two additional reagents are to balance the action of the developing agent, just as in the case of the sails and ballast of a ship. There is a fourth constituent added to the developer, to prevent staining by the new compound formed by the bromine combining with the developer. The fourth constituent keeps the developer clear. The developing agent may be pyrogallie acid. The accelerator is an alkali, because the developing agents are more ready to take up bromine in the presence of an alkali. Without this alkali, the plate would require a very prolonged treatment in the developer. Acetone or formic aldehyde may be used as accelerators. The retarder is generally

potassium bromide, and the stain preventer is usually sodium sulphite.

In the photographic print we have a reversal of the lights and shades of the negative. Although it is possible to get photographic prints in many materials, silver salts are the most common. In the earliest printing-out papers there was no film on the paper. The papers were 'sized' to try and keep the chemicals to the surface. Then followed the application of albumen to get a definite film upon the paper. Albumenized papers held sway for a whole generation. The paper was first floated on a solution, made by adding a little ammonium chloride to white of egg. When this was dry, it was floated upon a strong solution of silver nitrate. A print made on such paper and fixed with hyposulphite of soda would have a rather disagreeable red colour, and to rectify this and produce a print with a more agreeable purple, or a brown colour approaching black, the print was 'toned' in a solution containing gold or platinum. Then followed other forms of printing-out papers, among which were self-toning papers, which had the necessary gold salt added to the emulsion. In contradistinction to printing-out papers, there are 'bromide papers', in which a latent image is formed and developed as in the case of a negative. Bromide paper is paper prepared with a suitable surface and then coated with a bromide of silver gelatine emulsion, but the emulsion is made less sensitive than for negative work. These papers are known as 'gas-light papers', because they are exposed under the negative for a few seconds to the light from a gas-flame. The fixing-bath for a printed positive serves the same purpose as for a glass or film negative: to remove the unaffected chemicals, and thus prevent further action under the influence of light. There are other papers, giving a platinum and a carbon image, which give fine permanent results. For a cheap method of printing engineers' drawings, &c., a paper is coated with iron salt, and after exposure under a negative it is plunged into a solution of potassium ferricyanide. The salt that has been acted upon by light will give a dark-blue insoluble deposit with the ferricyanide, while the unaffected salt will be soluble, and can be washed away with water. The ferricyanide may be mixed with the iron salt and the paper coated with the mixture, then after exposure the print needs only to be washed in water (see *Cyanides*).

The application of photography to the production of moving pictures has been dealt with under *Cinematograph*. It plays an important part in the making of book illustrations. Its application in X-ray work is well known, as also its aid to the astronomer in recording the spectra of the different stars and in making a detailed survey of the heavens. It is a convenient

adjunct to microscopy in all its branches, one of which is in connection with metallurgy, enabling the student and the manufacturer to study the construction of the metals. In aviation it gives the aeronaut a means of recording a bird's-eye view of the country over which he passes. It also supplies the civil engineer with a quick method of surveying, one principle being as indicated in the illustration (fig. 3).

A is a negative of the landscape c, while B is a print of the negative. The lines joining similar points in A and B will produce the same angles as those joining the same points in A and c; therefore the angles for the distant landscape may be reproduced at any time by placing the point B the same distance from the optical axis

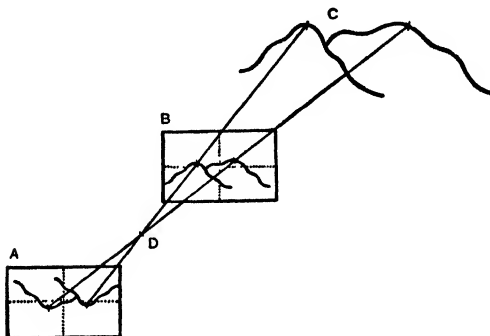


Fig. 3

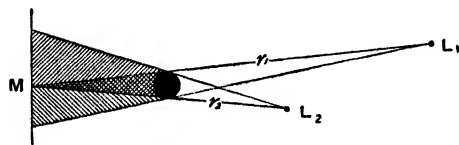
D as A is from it. The advantage in photogrammetry (q.v.), or photographic surveying, is that the field work may be done in a very short time, a permanent record being obtained immediately, but the work is not so accurate as with a plane table. There is a special camera or *phototheodolite* with the necessary scales; to be quite accurate, the camera would require to have a pinhole in place of a lens. By means of *telephoto lenses* photographs may be taken of very distant objects. Again, photographs may be taken by means of *ultra-violet light*, which has no effect upon our sense of vision; and the ether-waves beyond the red end of the spectrum, the *infra-red*, may also produce images on the photographic plate, although these rays cannot be detected by the eye.—BIBLIOGRAPHY: *Photography as a Scientific Implement*; Alfred Watkins, *Photography*; Chapman Jones, *Photography of To-day*; C. R. Gibson, *Romance of Modern Photography*.

Photometer, an apparatus used for comparing the luminous intensities of different sources of light. Let L be the light emitted per second by a small source of light; then the light which passes per second through unit area of a sphere of radius r with its centre at the source is $L/4\pi r^2$. This is a measure of the intensity of

illumination I of a screen at the distance r , and for normal rays I varies directly as the intensity of the source, and inversely as the square of its distance. Thus, if two sources of luminosities L_1 and L_2 produce equal illumination at distances r_1 and r_2 , $L_1/r_1^2 = L_2/r_2^2$, or $L_1/L_2 = r_1^2/r_2^2$, an equation which forms the basis of photometric calculations.

In Bouguer's photometer (1729) the two lights are set in front of a thin sheet of translucent paper divided by an opaque partition placed in front so that each source illuminates one-half of the screen only. By varying the distances of the lamps from the screen, equality of illumination is obtained, and a measurement of the distance of each source from the middle of the screen gives, by the above equation, the ratio of the luminosities. With other photometers a similar procedure is followed.

Rumford (1794) placed the sources on two tables set at about 60° . The screen was placed



Rumford Photometer

at the junction of the tables, and two vertical cylinders cast on the screen shadows which touched but did not overlap. The lamps were moved until the shadows were equally dark. In the common use of this photometer only one rod is employed to cast the shadows.

In Ritchie's photometer (1826) a white isosceles wedge is placed between the two illuminants with its edges vertical, and each of two sides receives light from one source. Viewing the wedge from the side, its position on the line joining the two lamps is adjusted until the two faces appear equally bright.

In Joly's photometer (1888) the wedge is replaced by two rectangular blocks of paraffin separated by tin-foil.

The modern form of Bunsen's photometer (1841) uses a sheet of paper, with a grease spot in the middle, placed between the two lights. The paper is moved between the sources until the appearance of the grease spot is the same as seen from either side. The comparison is rendered easier by setting two plane mirrors so that both sides of the grease spot can be seen simultaneously.

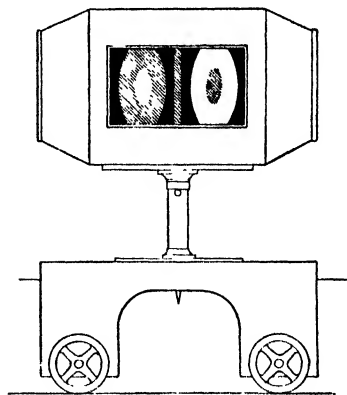
Lummer and Brodhun's photometer (1889) is a modification of an older form used by Swan (1849). The light from each source is reflected by different paths to the adjacent faces of a cube formed from a pair of right-angled prisms, the

hypotenuse sides of which are cemented by a central transparent patch of Canada balsam. The rays from one source pass straight through both prisms by way of the balsam, whilst the light from the other source enters the second prism and is totally reflected at the surface surrounding the balsam, and continues, parallel to the central beam, into a low-power microscope, by means of which the comparison is made.

The Flicker photometer was designed by Whitman (1896) to compare the luminosities of lights of different colours. By using a rotating sector, or a rotating wheel with a rim suitably bevelled or provided with a series of mirrors, the light is directed to the eye alternately from each source. A flickering effect is produced, which disappears when proper adjustment is made.

In order to reduce the photometric comparison to terms of candle-power, the luminosity of one source requires to be known. If one source is a standard lamp (see *Candle Standard*), the candle-power of the second lamp may be found. An electric glow-lamp forms a reliable sub-standard if its candle-power has been previously measured, and if it is used in conjunction with a voltmeter and rheostat.—Cf. A. P. Trotter, *Illumination*.

Pho'tophone, an instrument which transmits sounds by means of a beam of light. It was invented in 1878 by Bell and Tainter, and utilized the Bell telephone in conjunction with a selenium 'cell', the properties of which had been discovered by May five years previously. When light falls on a selenium cell or bridge, the electrical resistance of the cell diminishes, and



Bunsen Photometer

a stronger current is enabled to pass from a battery round a circuit which includes the cell. In the selenium cell used by Bell and Tainter, the resistance changed from about 1200 ohms in the dark to 600 ohms in the light. In the

photophone as used by these experimenters, sunlight was reflected from a mirror to a flexible reflecting membrane which directed the rays to a large parabolic mirror at the receiving-station. The rays were focused by the mirror on a selenium cell connected in series with a battery and telephone. When the voice of the speaker was directed on to the transmitting membrane, the latter vibrated in resonance, and, becoming alternately concave and convex, caused the reflected rays to become alternately convergent and divergent. The intensity of the light concentrated on the selenium cell thus varied with the same frequency as that of the sound-wave which actuated the membrane, and corresponding variations were impressed on the electric current through the telephone, which reproduced the sounds spoken into the distant membrane. Other forms of transmitter have been designed; in the most successful of these, the beam from an electric arc search-light was employed. The sound-waves actuated a microphone placed in a branch circuit of the arc, and variations of the current in the arc were caused, which gave rise to variations in the intensity of the transmitting beam of light. The speaking range has a limit of about 20 miles.—Cf. Ruhmer, *Wireless Telephony* (translated by J. E. Murray, 1908).

Pho'tosphere, literally 'sphere of light', the shell of incandescent matter which forms the luminous surface of the sun, and from which we chiefly receive its light. The photosphere is overlaid by the reversing layer, in which occurs the absorption producing the Fraunhofer lines, by the chromosphere, and the corona.

Photosynthesis. See *Carbon Assimilation*.

Phragmites (frag-mi'téz), a genus of large grasses widely spread, and usually known as reeds. *P. communis*, the only British species, is the largest grass in the British Islands.

Phrenol'ogy (Gr. *phrên*, mind, *logos*, discourse), the term applied to the wild speculations of Gall and Spurzheim, founded upon (1) the claim that the brain, as the organ of the mind, is not so much a single organ as a complex congeries of organs; and (2) the supposed existence of a certain correspondence between the aptitudes of the individual and the configuration of his skull. The development of physiology has shown that while there is some slight justification for the underlying principle, the scheme elaborated by Gall and Spurzheim is wholly fantastic and false.

Phrygia, in ancient geography a region comprising the western-central part of Asia Minor, containing the cities Apamea, Laodicea, and Colossæ. The inhabitants were early civilized, and paid much attention to grazing and tillage. The early history of Phrygia is mythological.

Several of its kings of the names of Gordius and Midas are mentioned. On the death of Adrastus (560 B.C.) the royal family of Phrygia became extinct, and the kingdom became a province of Lydia. It afterwards formed a part of the Persian, and still later of the Roman Empire.

Phry'nichus, Greek comic poet, a contemporary and rival of Aristophanes, who accused him of vulgarity and plagiarism. His plays are all lost, only a few fragments surviving. Aristophanes beat Phrynichus's *Solitary* with the *Birds*, and his *Muses* with the *Frogs*.

Phycomycetes, or **Lower Fungi**, a common name for the lower and more primitive families of the Fungi (q.v.).

Phylac'tery (Gr. *phylacterion*, safeguard), among the Jews strips of parchment inscribed with certain texts from the Old Testament, and enclosed within a small leathern case, which is fastened with straps on the forehead just above and between the eyes, and on the left arm near the region of the heart. The four passages inscribed upon the phylactery are *Ex.* xiii, 1-10, 11-16; *Deut.* vi, 4-9; xi, 13-21. The custom was founded on a literal interpretation of *Ex.* xiii, 16; *Deut.* vi, 8; xi, 18. The word occurs only once in the New Testament (*Matt.* xxiii, 5), in the discourse of the Saviour against the Pharisees. The Jews call the phylacteries *tephillin*, plural of *tephillah*, a prayer. The orthodox Jews still consider it a sacred religious duty to wear the phylacteries during morning prayer every day except on Saturdays and high festivals. In their origin they were regarded as amulets, which protected the wearer from the power of demons, and hence their name.

Phyllode, in botany, the name given to a leaf-stalk when it becomes developed into a flattened expansion like a leaf, as in some Australian species of acacia and certain other plants.

Phyllop'oda ('leaf-footed'), a sub-order of Crustacea, possessing numerous feet, numbering eight pairs at least, the first pair being natatory in character. The feet are of foliaceous or leaf-like structure, and are provided with branchial appendages, adapted to subserve the breathing or respiratory function. The carapace, or shelly covering protecting the head and chest, may be well developed, or the body may be destitute of a covering. In their development the Phyllopoda pass through a metamorphosis; and in their earliest state the embryos appear as in the 'nauplius' form (see *Nauplius*). All the Phyllopoda are of small size. The order is represented by the familiar 'fairy shrimps' (*Chirocephalus*), met with in freshwater ponds, and the curious 'brine shrimps' (*Artemia*), found in the brine-pans of salt-works, and in the salt lakes of both the Old and New Worlds.

Phyllostomatidæ, the vampire bats, an American family of bats, including the true blood-sucking vampire (*Desmodus rufus*). See *Vampire-bat*.

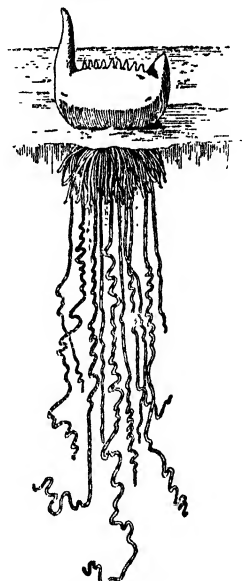
Phyllotaxis, in botany, the mode of insertion of leaves on the axis. Many ingenious theories have been advanced to account for the almost mathematical exactness of phyllotaxis, but the problem is still unsolved.

Phylloxera, a genus of plant-lice, family Aphidæ, ord. Hemiptera. The type of the genus is *Phylloxera quercus*, a species which lives upon oak trees; but the *Phylloxera vastatrix*, or grape Phylloxera, a species which injuriously affects

Australia, at the Cape of Good Hope, and in Algeria; and, generally speaking, it has now obtained a foothold, at least in restricted localities, in every country where the grape-vine is cultivated. Vines attacked by *Phylloxera* generally show external signs the second year of attack in a sickly yellowish appearance of the foliage and in stunted growth, and the third year they frequently perish, all the finer roots having decayed. Grafting European on American vines has proved the best means of checking this pest.

Phylogenesis, or **Phylogeny**, in biology, the race-history of an animal or vegetable type, a term much used by evolutionary biologists and philosophers. It has been shown that ontogenesis, or the life-history of an individual, is a more or less imperfect recapitulation of its phylogenesis (Law of Recapitulation).

Physalia, a genus of marine animals of the class Hydrozoa, of the sub-class Siphonophora. The *P. atlantica* is known by the name of the *Portuguese man-of-war*. These hydrozoa are characterized by the presence of one or more large air-sacs, by which they float on the surface of the ocean. Numerous tentacles depend from the under side, one class short and the other long. The shorter are the nutritive individuals of the colony; the longer, which in a *Physalia* 5 or 6 inches long are capable of being extended to 12 or 18 feet, possess a remarkable stinging power, and are probably used to stun their prey.



Physalia Megalista



Leaves of Acacia

a, b, Phyllodes.

the vine, has attracted so much attention by its ravages that it has come to be known as the *Phylloxera*. It presents itself in two types, the one gall-inhabiting (*gallicola*), and the other root-inhabiting (*radicola*). Its proper home is North America, where it was known early in the history of grape-culture, and where it doubtless existed on wild vines from time immemorial. It was discovered in England in 1863, and about the same time it made its appearance in France, where it committed great ravages, inflicting immense loss upon the owners of vineyards. Widening its area not only by natural means, but also by commerce in vines and cuttings, it was carried from infected to non-infected districts, and spread to Spain, Portugal, Switzerland, Austria, Prussia, and to all the grape-growing countries of Europe. Only where the soil was of a sandy nature did the vineyards escape. In 1885 its presence was discovered in

Physical Chemistry may be defined as the science which deals with the *mechanism* of chemical phenomena. It attempts to find an 'explanation' of the observational facts of inorganic chemistry, organic chemistry, colloid chemistry, bio-chemistry, and chemical technology. By the term 'explanation' is meant the restatement of the chemical phenomenon in terms of purely physical (i.e. mechanical) concepts, that is, the demonstration that the chemical phenomenon is precisely what is to be expected, provided certain mechanical theorems or principles are applicable to the behaviour of

those excessively minute material units in terms of which chemical change takes place. These material units are the molecules of which matter in bulk is composed, molecules themselves possessing an atomic and ultimately an electronic structure (see *Matter; Rays, Electric; Radioactivity; Electron; Ionization*). The development of physical chemistry has been rendered possible by the application of two, or possibly three, different modes of treatment. The first consists in the application of the kinetic molecular theory. The second mode, namely the thermodynamical, was first applied by Horstmann (1869), whilst the third mode, namely the application of statistical mechanics together with its modification known as the Quantum Theory (q.v.), has only recently begun to play a part in the development of chemical theory.

Examining a chemical phenomenon from the point of view of elementary kinetic molecular theory, we attempt to visualize the occurrence in terms of the molecules, atoms or electrons taking part, attributing to these natural units purely mechanical properties, such as mass, velocity, momentum, forces of attraction and of repulsion (see *Dynamics; Kinetics*). The word elementary is used here to indicate that we artificially simplify the actual mechanism by attributing *average* values to molecular properties. On this basis, the reaction between two molecules in a gaseous mixture, for example, is regarded as due primarily to collisions. The more frequent the collisions, i.e. the more highly concentrated the gas mixture, and the higher the temperature, the more rapidly does the chemical change take place (see *Kinetic Theory of Gases*). Recent investigation has indeed shown that other considerations enter, notably that the molecules must be in a certain state or condition in respect of internal energy before a collision will be chemically effective. Apart from this, however, it has been found possible to express chemical reactivity in terms of a law, the Law of Mass Action (see *Mass Action*), according to which the rate of chemical change between two different molecules is proportional to the product of the concentrations of the two gases in the mixture. Applying this idea to two opposing reactions, we arrive at the concept of *chemical equilibrium*, essentially dynamic, due to the existence of equal and opposite rates of chemical change.

In the thermodynamic treatment of chemical processes we set aside completely all molecular considerations (see *Thermodynamics*). Thermodynamical reasoning is based entirely on the concept that all material changes are accompanied by energy changes, and from the thermodynamic point of view the latter alone are considered. This mode of treatment is characterized by its

generalized nature, as distinct from the specialized concepts involved in the kinetic molecular theory. There are two classical principles or laws upon which thermodynamical considerations rest, and the introduction of these into chemistry has led to conclusions, e.g. the colligative properties of solutions (see *Solution*), which could not have been obtained on any other basis. The very generality of treatment which characterizes thermodynamics makes it difficult to apply, but once it is applied, the conclusion is unassailable. Since the concept of time is absent from thermodynamical reasoning, we cannot, by this method, deal with a phenomenon such as chemical rate or velocity. We can deal, however, with chemical equilibrium, and it is possible, for example, to calculate with precision the effect of an alteration in temperature upon the position of the equilibrium finally attained in a chemical process, in terms of the heat of the reaction, chemical reactions being accompanied in general by an evolution or an absorption of heat. As a further example of its utility it may be mentioned that thermodynamical reasoning has to a large extent solved the problem of determining quantitatively what is meant by the term *chemical affinity*, a term the very familiarity of which has somewhat obscured its indefiniteness. This problem has, in fact, within recent years involved a considerable extension of the fundamental concepts of thermodynamics themselves, by indicating the existence of a new principle, the so-called Third Law of Thermodynamics.

The introduction of statistical mechanics into chemical processes is in a sense a return to the kinetic molecular theory, but on an altogether wider basis. We no longer regard every molecule in a material system as identical in all respects with every other molecule. We recognize that there are individual physical differences which must be allowed for. Since, however, there are vast numbers of molecules in any system, even the most dilute, with which we usually deal, it is obviously impossible to consider each molecule by itself, more especially as every molecule is changing in various ways with the time. Instead, we make allowance for individual characteristics by introducing *probability considerations* into the purely mechanical theory adopted. On this basis we know, with regard to the speed of molecules for example, that in a system consisting of many molecules a large proportion possesses speed which lies very near to a 'most probable speed', whilst only a very small proportion possesses either very large or very small speeds relative to the most probable value. It is almost certain that the internal energy in the molecules is distributed in a similar manner, and the conclusion has now been reached that it is only that

very small fraction of the total molecules, which possesses excessively great internal energy, which is really concerned in chemical changes. On the basis of what is now known as classical statistical mechanics, the variation of, say, internal energy amongst molecules is regarded as continuous, that is, the internal energy of any individual molecule might differ by an *infinitely* small amount from the energy of another molecule. The most recent development of statistical mechanics, known as the *Quantum Theory*, virtually denies this, and replaces it by the concept of discrete alterations in energy content in *finite* (though still very small) amounts. Each of these minimum amounts is known as a quantum. This is only a crude way of expressing the idea, but it is sufficient to indicate the essential characteristic of quantum treatment. The introduction of such ideas into chemical theory has only taken place within the last few years, but it has already become evident that the ultimately satisfactory theory of chemical processes will be attained on this basis. For bibliography see *Chemistry*.

Physicians, Royal College of (London), a body which owes its origin to the exertions of Thomas Linaere, one of the physicians of Henry VIII, who, through the influence of Cardinal Wolsey, obtained in 1518 from that monarch letters patent incorporating himself with certain other physicians named, and all other men of the same faculty in London, as one body. Various privileges were accorded to them, the chief of which was that of prohibiting anyone from practising as a physician in London, or within a circuit of 7 miles round it, unless he had first obtained a licence from this corporation. A charter granted four years later confirmed the privileges of the body, except that graduates of Oxford and Cambridge were permitted to practise within the jurisdiction of the college without previously being examined by it. Various charters have been granted to the body subsequently, but since the passing of the Medical Act of 1858, by which any duly qualified practitioner is entitled to practise according to his qualifications in any part of His Majesty's dominions, the licence of the college is not necessary to those practising in London or within 7 miles round. The Royal College of Physicians of London is represented by one member in the General Medical Council established by the Medical Act of 1858. The college consists of fellows, licentiates, and members, the first being elected from among the members, whilst the others are admitted by examination. The building of the college, formerly in Warwick Lane, is now situated in Pall Mall East, London. The Royal College of Physicians, Edinburgh, was incorporated by royal charter dated the

26th of Nov., 1681, and empowered to make laws for promoting the art of physic, and to regulate the practice thereof in Edinburgh and Leith. Its fellows and licentiates are entitled to be registered as qualified medical practitioners. The Royal Faculty of Physicians and Surgeons, Glasgow, has a like status, and combines with the Royal College of Physicians, Edinburgh, and the Royal College of Surgeons, Edinburgh, to grant a triple qualification, after a joint examination.

Physic-nut, the seed of the *Jatropha curcas*, or the plant itself, a shrub belonging to the nat. ord. Euphorbiaceæ, a native of intertropical countries, principally the East and West Indies. The seeds have strong emetic and purgative properties, due to a fixed oil used in medicine, under the name of *Jatropha-oil*, for the same purposes as croton-oil, although it is less powerful. French or Spanish physic-nuts are the seeds of *J. multifida*, and yield Oil of Pinhoen, similar in its properties to Jatropha-oil.

Physics is a general term signifying the aggregate of the sciences dealing with such natural phenomena as motion, force, heat, light, sound, electricity, magnetism, elasticity, capillarity, osmose, diffusion, solution, and change of state. Its scope extends over all properties of matter which are not specifically biological or chemical. Aristotle's treatise τὰ φυσικά, from which the word physics is derived, embraced nature-knowledge of all kinds, but chemistry and biology are not now reckoned to belong to the realm of physics, though biological facts and processes have their physical aspect, and the dividing-line between physics and chemistry is hard to draw. In biology, for example, the methods of physics apply to such subjects as measurement of sap- and blood-pressure, and the mechanics of the skeleton and muscles, but physics takes no account of the special character of living matter: thus the physical theory of *sound* deals with the mechanics of wave-motion and the mechanism of the ear, but stops short at the threshold of sensation of sound.

It may be taken that physics attempts to classify and explain natural phenomena in terms of certain special concepts, such as attraction and repulsion, cohesion, temperature, state of aggregation, as well as motion, mass, force, stress, strain, and energy. Chemistry and astronomy are really departments of physics, to which independent status has been given, the former dealing with a very special type of physical event, called chemical action, while the latter is simply the physics (including the dynamics) of the celestial bodies. In Britain there has been a tendency to restrict the signification of *physics* by excluding dynamics, 'natural philosophy' being used to denote physics in the wider sense.

Such sciences as geology and mineralogy, which lean towards description and history rather than towards causal analysis, are not usually classed under physics, but rather as branches of natural science, along with such biological sciences as botany, zoology, &c.

Amongst the physical sciences, dynamics has premier place, as its fundamental concepts—matter and motion—are pre-eminently simple and precise. In the development of physics there has been a continual effort to explain all physical phenomena in terms of the dynamics of matter and ether. Great advances in this direction were made in the nineteenth century, with the result that the most important chapters in the textbooks of physics have now an essentially dynamical character. The names of Laplace, Poisson, Fourier, Fresnel, Young, Faraday, Thomson, Joule, Maxwell, Gauss, Helmholtz, Hertz, and others will always be associated with these great advances.

The twentieth century has already witnessed a rejuvenation of the whole of physical science through the remarkable achievements in divining and observing not merely the atomic constitution of matter, but even the structure of the atoms, and in detecting the motions and mutual actions of the electrons and nuclei which compose them. Radio-activity, electron, quantum, these are the magic words of the new century which are expected to give the clue to many a hitherto hidden secret of nature.

Perhaps the most comprehensive recent treatise on physics is that of O. D. Chwolson, of which a French edition has appeared in five large volumes. Amongst the shorter general treatises, the English editions of the works of Deschanel and of Ganot, and W. Watson's *Textbook* may be recommended. There are numerous excellent textbooks on special branches (heat, optics, &c.). For recent advances, W. C. D. Whetham's *The Recent Development of Physical Science* (1909), and the yearly *Reports* of the British Association may be consulted. The *Philosophical Magazine* is the chief British periodical devoted to physical science.

Physiocratic System (Gr. *physis*, nature; *kratein*, to rule), a system of political economy. It was advocated by a French school which flourished in the second half of the eighteenth century, and the members of which wrote against the abuses of the mercantile system. It was a system of government based on nature, and was supposed to lead to justice and order. The watchword of the Physiocrats, who were known to their contemporaries as *les économistes*, was *laissez faire, laissez passer*, and they advocated industrial freedom, natural liberty, and the advancement of agriculture. The term *physiocratic* was first used in 1799 by Du Pont de

Nemours. The head of the school and the founder of the system was Francis Quesnay (1694–1774), physician of Louis XV, who was a follower of Descartes and in favour of the reign of natural law (hence *physiocracy*). Quesnay observed the very depressed state of agriculture in France whilst travelling with the king, and ascribed it to the mercantile system introduced under Colbert, which favoured the industry of the cities. He published his *Tableau économique avec son explication* (1758), and developed his system in his *La Physiocratie, ou constitution naturelle du gouvernement le plus avantageux au genre humain* (Paris, 1767). A whole school, called the Physiocratic, soon sprang up. It was not, however, until the reign of Louis XVI, under the minister Turgot, that the followers of the system came into office. Their authority again sank, but in the Revolution they had for several years a decided preponderance in the Convention. Joseph II of Austria, and Leopold of Tuscany, his brother, were friendly to the system, but did not allow the perfect freedom of trade which it recommended. The principles of the physiocratic system are: (1) The earth is the only source of all national wealth; and only those who use or increase the natural powers operating in the vegetable and animal kingdoms, as farmers, fishermen, herdsman, or miners, add to the amount of national wealth. All other workers, such as mechanics, manufacturers, or merchants, produce nothing which can increase the public wealth; they only change the form of the articles produced by the former classes, and their wages will always be paid by the surplus of raw products which the farmer saves from his own consumption. The merchant only promotes the exchange of goods. Still less is it in the power of public officers and men in similar employments to increase the elements of wealth. (2) All members of the community, therefore, are divided into productive and unproductive. To the latter class belong scholars, artists, mechanics, merchants, &c., because all of them are to be supported by the productions of the earth, without having assisted directly in producing them. What they save from the wages received from the mass of the natural products, in various forms, contributes, indeed, to national wealth, and they become thereby a useful class of citizens, indirectly increasing wealth. It is only by their means, moreover, that the agriculturist is enabled to devote himself exclusively to the tillage of the soil. (3) From this it follows that the unrestricted exercise of all honest occupations is necessary to the wealth of both classes. The physiocratic system inculcates freedom in regard to foreign commerce, as well as to the mechanic arts, considering it a matter of indifference

whether the products of a country are consumed by natives or by foreigners. (4) As according to this system all wealth is derived from the soil, the only subject taxed should be the net produce of the soil.

Without criticizing this system in detail, it may be pointed out that it is based upon a misconception of nature and its products. The fire of the steam-engine is as much a productive natural power as that producing grain, and the plough as much a machine as the steam-engine. Besides, if wages are regulated by the 'iron law', both in commerce and manufactures as well as in agriculture, then the 'net product' is made up of wealth created by the three classes, agricultural, manufacturing, and commercial.—
BIBLIOGRAPHY: H. Higgs, *The Physiocrats*; Yves Guyot, *Quesnay et la physiocratie*; R. Sabatier, *La Théorie du commerce chez les physiocrates*.

Physiog'nomy, the subject which treats of the means of judging character from the countenance. Aristotle is the first who is known to have made any attempts in physiognomy. He observed that each animal has a special predominant instinct, as the fox cunning, the wolf ferocity, and so forth, and from this he concluded that men whose features resemble those of certain animals will have similar qualities to those animals. Baptista della Porta, in his work *De Humana Physiognomia* (1586), revived this theory and carried it further. The theory was adopted and illustrated by the French painter Lebrun, in the next century, and by Tischbein, a German painter of the eighteenth century. The anatomist Camper sought new data in a comparison of the heads of different types of the human family, and in attempting to deduce the degree of intelligence belonging to each type from the size of the facial angle. Lavater was the first to develop an elaborate system of physiognomy, the scope of which he enlarged so as to include all the relations between the physical and moral nature of man. See *Lavater*.

Physiography, or **Physical Geography**, one of the great divisions of general geography which treats of the natural features of the earth's surface and their distribution, and of the general relationship of the lithosphere (earth's crust) to the hydrosphere (watery envelope) and atmosphere (gaseous envelope), and, in a lesser degree, considers the interrelationship of the two latter forms with reference to the biosphere, or organic life upon the earth. There is no clearly defined line of demarcation between physical geography and physiography. Some authorities, indeed, such as Linnaeus and Huxley, give the term physiography a narrower meaning, but it will be used here as comprehending the whole subject of physical geography.

Physiography is defined by Herbertson (*Guide to Geographical Books*) as "the systematic study of the forces of nature, and their effects in their local and general aspects". Dynamical geography (*geodynamics*) is directly concerned with the distribution of forces, the study of the distribution of forms being covered by morphological geography (*geomorphology*). Geomorphology, however, is not only concerned with the distribution of forms on the lithosphere, it also seeks to describe their structure. In its broadest definition it is concerned with the shape of the earth as a whole, and with the forms and subdivisions of the lithosphere, hydrosphere, atmosphere, and biosphere, but it is usually restricted in meaning to the consideration of land or crust

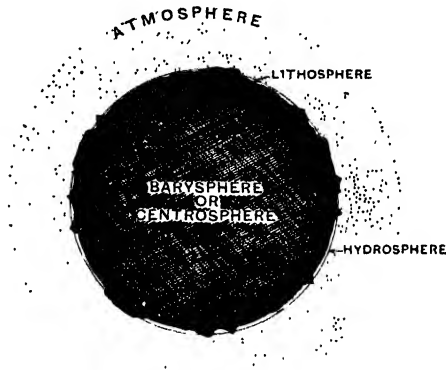


Diagram of the Four Concentric Zones of the Earth

forms only. Physiography is in no small degree dependent upon the results of three other sciences, although it has no interest whatever in the processes by which these results are obtained. A study of land forms would be very unsatisfactory without a corresponding consideration of their origin, and in this phase geology and physiography overlap and are mutually indispensable. Meteorology is applied to the study of physiography through climatology; sunshine, temperature, and moisture being the principal subjects considered. Oceanography and hydrography perform for the oceans the functions exercised by meteorology in relation to the atmosphere, but with certain modifications. As in the case of geology, so much overlapping occurs between physiography and the two latter sciences that it would be difficult if not impossible to define their respective limits.

Physical conditions exert an enormous influence on the organic life of the lithosphere, and determine, in a greater or less degree, the kind of people who shall live on a particular part of the earth's surface, their mode of life, manner

of dress, state of comfort, wealth, and health. Vegetable life is also dependent upon favourable physical conditions, and to man, as other mammals, vegetation is as imperative a necessity as water. From these considerations it follows that no study of physiography could be complete without a passing note of how uncontrollable physical conditions have affected organic life.

In the physiographical review of any region a close investigation of the following features will provide a handy skeleton of the complete structure.

1. *Land*.—Shape and size; orography, i.e. highlands, mountains, plateaux, &c.; watersheds; plains and peneplains; valleys and passes; coastal features, i.e. gulfs, bays, &c.; vegetation; geological structure and nature of rocks, folds, faults, rift valleys, &c.

2. *Water*.—Bathymetrical study of ocean; currents; lakes; river systems; coastal features (including estuaries, bays, and gulfs, &c.); submarine land forms, i.e. depressions, basins, troughs, trenches, deeps, rises, ridges, plateaux, &c.

3. *Air*.—Climate, including temperature, rainfall, sunshine, prevailing winds, &c.

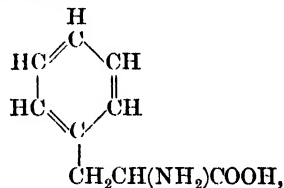
It is important to consult such articles as *Earth; Hydrography; Oceanography; Meteorology; Geography; Geology; Earthquake; Climate; &c.*; and physiographical notes on various countries.

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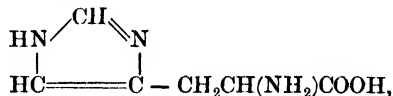
Physiological Chemistry. The living cell consists of a mixture of organic and inorganic substances dissolved or suspended in water, the water constituting about three-fourths of the total mass of the cell. Of the organic substances, *proteins, carbohydrates, and fats* are the most important. The simpler organic materials are mostly stages either in the synthesis or decomposition of these substances. Of the three groups, proteins, carbohydrates, and fats, the proteins alone contain nitrogen in their molecule. On decomposition the proteins yield various *amino-acids* (fatty or dibasic acids in which one or more of the hydrogen atoms has been replaced by an NH_2 group), according to the type of protein decomposed. This fact, coupled with the well-

known work of Emil Fischer, who showed that amino-acids could be linked together in acid-amide chains, i.e. the COOH group of one combining with the NH_2 group of the next, $(\text{CH}_2(\text{NH}_2)\text{CO}[\text{OHH}]\text{HNCH}_2\text{COOH})$, thus forming a peptide, and that, if the chains so formed included sufficient and the proper type of amino-acids, many of the characteristic reactions of proteins could be obtained, has proved that the various proteins consist of unions of various amino-acids.

Amino-acids may have one amino-group in their molecule, as in *glycine*, $(\text{CH}_2(\text{NH}_2)\text{COOH})$, or two, as in *ornithine*, $(\text{CH}_2(\text{NH}_2)\text{CH}_2\text{CH}_2\text{CHNH}_2\text{COOH})$. Amino-derivatives of dicarboxylic acids are also found, e.g. *aspartic acid*, $(\text{HOOCCH}_2\text{CH}(\text{NH}_2)\text{COOH})$, as also similar derivatives of sulphur-containing acids, e.g. *cysteine*, $(\text{CH}_2\text{SHCH}(\text{NH}_2)\text{COOH})$. Again, the amino-acid may be linked to a cyclic compound, as in *phenylalanine*,

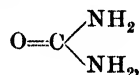


where the amino-propionic acid is combined with a benzene ring; or to an heterocyclic compound, as in *histidine*,

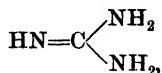


where amino-propionic acid is combined with the iminazole ring. Of the amino-acids, *tyrosine* and *tryptophane* deserve special mention. Tyrosine, a compound of amino-propionic acid with hydroxybenzene, and present in many proteins, is of importance as a source of the organic or ethereal sulphates of the urine. By bacterial action in the intestine, the amino-acid is separated and the remaining phenol is absorbed, then combined with acid potassium sulphate to render it non-toxic, and excreted in this form in the urine. Tryptophane, a compound of amino-propionic acid with the heterocyclic indol ring, under bacterial influence in the intestine, forms *indol* and *methylindol* or *scatol*, and these substances similarly form the *indoxyl* and *scatoxyl sulphates* of the urine.

Other Nitrogenous Substances of Physiological Importance.—Urea,

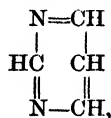


regarded as the diamide of carbonic acid, is formed in the body by the dehydration of the ammonium carbonate, which results from a combination with carbonic acid of the ammonia produced from the NH_2 groups of waste amino-acids. *Guanidine*,



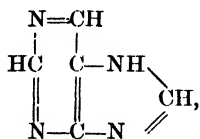
a substance, as the formula shows, intimately related to urea, has been found in the human subject in the form of methyl- and dimethyl-guanidine in the urine, blood, and certain tissue extracts. It is also a constituent of most proteins in the form of *arginine*, a compound of guanidine and amino-valerianic acid. Guanidine, chemically, and possibly metabolically, is also related to *creatine* (methyl-guanidine-acetic acid). This substance is a constant constituent of muscular tissue, and its anhydride, *creatinine*, is a normal constituent of all mammalian urines.

Of derivatives of the *pyrimidine* structure,



three substances, *uracil* or dioxypyrimidine, *thymine* or methyl-dioxypyrimidine, and *cytosine* or amino-oxy-pyrimidine, occur as components of *nucleic acids*.

From the substance *purine*, of structural formula,



which, it will be noticed, is a combination of the pyrimidine and iminazole nuclei, several substances, the interrelation of which is shown in the following formulæ, *purine*, $\text{C}_5\text{H}_4\text{N}_4$; *hypoxanthine*, $\text{C}_5\text{H}_4\text{N}_4\text{O}$; *xanthine*, $\text{C}_5\text{H}_4\text{N}_4\text{O}_2$; *uric acid*, $\text{C}_5\text{H}_4\text{N}_4\text{O}_3$; *adenine*, $\text{C}_6\text{H}_5(\text{NH}_2)\text{N}_4$; *guanine*, $\text{C}_6\text{H}_5(\text{NH}_2)\text{N}_4\text{O}$, are derived. Hypoxanthine and xanthine are found widely distributed in the tissues of both animals and plants, as also adenine and guanine, which, in addition, are constituents of the nucleic acids. In the human organism all are ultimately changed into the most highly oxidized form, viz. uric acid.

The *nucleic acids*, united with proteins, form the nucleoproteins of the cell-nuclei. They consist of phosphoric acid, a carbohydrate, two purine bases, and two pyrimidine bases, the exact way in which these components are combined

being unknown. The carbohydrate of the animal nucleic acids is a hexose (see below), that of plants a pentose, the pyrimidine bases of the animal type being cytosine and thymine, those of the vegetable world cytosine and uracil.

Of the metabolism of the *sulphur* of the protein molecule little is known, but cysteine, already mentioned, is probably an intermediate product. An oxidation product of cysteine, viz. *taurine*, is found in combination with a complex acid, *cholalic acid*, in the bile. A similar compound of this acid with glycine, *glycocholic acid*, is also a constituent of bile.

The Carbohydrates.—These are so called because of their empirical formula, $(\text{CH}_2\text{O})_n$, representing a combination of carbon and water. There may be any number of carbon atoms from two to nine in their molecule, those of most physiological importance having five or six. The *hexoses*, or 6-carbon atom type, are often called sugars. They may exist as single molecules, the *monosaccharides*, or two molecules may combine together with loss of water, giving the formula $\text{C}_{12}\text{H}_{22}\text{O}_{11}$, forming the *disaccharides*. Further combination of more molecules with loss of water gives rise to *tetra-* and *polysaccharides*. Similar combinations may occur among numbers of the *pentose* or 5-carbon atom group.

The pentoses are widely distributed in plants as a component of their nucleic acids.

Hexoses.—*Monosaccharides*. The most important are *glucose*, *lævulose*, and *galactose*. Glucose occurs in sweet fruits, honey, &c., and is an aldehyde, i.e. it possesses a CHO grouping, its formula being $\text{CH}_2\text{OH}\cdot\text{CHOH}\cdot\text{CHOH}\cdot\text{CHOH}\cdot\text{CHOH}\cdot\text{CHO}$. Lævulose is also found in fruits; it is an example of a ketone sugar, possessing a CO grouping, $\text{CH}_2\text{OH}\cdot\text{CHOH}\cdot\text{CHOH}\cdot\text{CHOH}\cdot\text{CO}\cdot\text{CH}_2\text{OH}$. Galactose is found mainly in combination with glucose in milk-sugar (lactose).

Disaccharides. Of these there are many, the most important being *cane-sugar*, a combination of glucose and lævulose; *lactose*, consisting of glucose and galactose; and *maltose*, made up of two glucose molecules.

Polysaccharides. The most important are those composed of glucose units. To this group belong *vegetable starch*, the *dextrins*, *glycogen* or *animal starch*, the form in which the carbohydrate excess of the animal body is stored, and *cellulose*, which forms the basis of the cell-walls of plants.

Along with the carbohydrates must be mentioned two acids which are probably products of their metabolism. *Lactic acid* or hydroxy-propionic acid, $(\text{CH}_3\cdot\text{CHOH}\cdot\text{COOH})$, plays an important rôle in muscular contraction; and *pyruvic acid*, $(\text{CH}_3\cdot\text{CO}\cdot\text{COOH})$, is of importance because, since its formation from aminopropionic acid and its synthesis to higher fatty acids have

been shown to be possible, it may represent the turning-point in the interchange, one into another, of proteins, carbohydrates, and fats.

The Fats.—Fats and oils are combinations of the higher fatty acids, mainly *stearic*, *palmitic*, and *oleic*, with the trihydric alcohol *glycerol*. Palmitic and stearic acids are saturated acids, i.e. each valency of every carbon atom is satisfied. Oleic is an unsaturated acid, there being a double linking in the middle of the chain, ($-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-$). The position of such double linkages probably determines the point of rupture of the molecule in its biological oxidation. The lower fatty acids occur to a small extent in many fats and fatty secretions like milk. Higher alcohols, such as *cholesterol*, are also found, particularly in nervous tissue, bile, and red blood-corpuscles, and also united to higher fatty acids, forming waxes. The decomposition of fat is believed to take place by the introduction of double bonds (desaturation) and by a series of oxidations at the penultimate CH_2 grouping (the β position). The ultimate result of these processes would be the formation of β -hydroxybutyric acid. Normally this is completely oxidized to carbonic acid and water, but in defective fat metabolism β -hydroxybutyric acid, along with its oxidation products *diacetic acid* and *acetone*, may appear in blood and urine. Along with the fats may be mentioned somewhat similar compounds which contain phosphorus and nitrogen in their molecule, the *phosphatides* or *lipins*, e.g. *lecithin*, where two of the replaceable hydrogen atoms of glycerol are replaced by palmitic acid, and the third by phosphoric acid and a nitrogenous base, *choline*.

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Physiology is the study of the phenomena presented by *living* organisms, whether animal or vegetable. Vegetable physiology, however, belongs rather to the province of botany, and the study of animal physiology has been directed mainly to the higher animals and particularly to man. Hence the following brief outline is largely that of human physiology. It is a consideration of how the mechanism of the body works.

In early and in mediæval times philosophers employed their energies in speculations as to the functions of the various organs and parts of the body with which the study of anatomy had made them familiar. These speculations were limited only by the imagination of the theorist, and, as they were wholly unsupported by observation or experiment, they not only failed to

advance knowledge, but even acted as a barrier to real progress. With the advent of the Baconian philosophy, which demanded not theories but facts derived from observation and experiment, physiology freed itself from the trammels imposed by the schoolmen and rapidly attained the dignity of an experimental science. Since then progress has been slow but sure: slow, because of all experimental sciences physiology presents probably the greatest difficulties; sure, because the advance has been based on gradually accumulated facts.

The methods employed in the investigation of the body processes are those of the chemist and the physicist. We are learning more and more to apply such methods to physiological problems, and with advances in the fundamental sciences of chemistry and physics new methods become available to the physiologist. No person can hope to understand the problems of physiology who has not a competent knowledge of chemistry and physics.

Since physiology is concerned with the phenomena of life, we must first endeavour to explain what constitutes life. The main characteristics of a living organism are that it is capable of (1) taking in and utilizing food, (2) reacting to changes in its surroundings, (3) growing, (4) reproducing itself. Some organisms consist of a single cell, but all the higher forms of life are aggregations of vast multitudes of cells. Every cell, however, is composed of a living material called *protoplasm*, and it is this which exhibits the properties just mentioned.

Structure of the Body.—It is obvious that different parts of the body are composed of very different materials, e.g. we have bone, muscle, fat, &c. This difference in structure is associated with a difference in function or division of labour. Certain cells are grouped together and specialized to perform one particular process.

Thus we have bone—forming a rigid support for the soft tissues; muscle—capable of contracting; skin—forming a covering for the body; mucous membranes—lining the hollow internal organs; glands—aggregations of cells which secrete fluids; nervous tissue—for conducting nervous impulses.

These specialized cells are grouped into organs and systems. Each system subserves certain requirements and contributes its quota to the needs of the body, but it is essential to regard the different systems as interdependent. No one system can function abnormally or cease to function without seriously interfering with the others.

Metabolism.—Protoplasm exists in a state of incessant change. It is being continuously built up and broken down. The sum total of these changes is termed *metabolism*. Such a process

necessarily involves the expenditure and the storing up of energy. Now one of the greatest general laws of the physical world is that of conservation of energy, which affirms that energy cannot be created, although it may be transformed and appear as work or as heat.

The body is no exception to this law. It cannot manufacture energy, but must receive it in the form of food. Food contains large stores of potential energy which the body has the power of liberating. In the tissues of the body there is a considerable reserve of potential energy which can be drawn on if necessary, as in complete or partial starvation. This device can be resorted to only for a limited time, and during that time the body steadily wastes away. If, on the other hand, more energy (i.e. food) than is necessary is supplied, the surplus is got rid of in the form of heat. For the most part heat derived from food is not wasted, as a certain temperature is required for the survival of warm-blooded animals.

Food.—Food is to the body what fuel is to the engine. Neither can continue to function unless it is fed. Any food, no matter of what form, can be shown to belong to one of three great classes, viz. *proteins*, *carbohydrates*, and *fats*. All these contain the elements carbon, hydrogen, and oxygen, but the proteins contain in addition nitrogen and sulphur. Food-stuffs, as a rule, are not composed entirely of one class, but have greater or less quantities of the others admixed. For example, meat is chiefly protein, bread is chiefly carbohydrate, and butter is almost all fat. See *Physiological Chemistry; Foods and Food Values*.

Foods as ingested are inert, but the large amount of carbon they contain can be oxidized, i.e. it can form a chemical compound with oxygen, and in so doing can liberate a large quantity of energy, just as coal does when it is burnt. The body has the power of carrying out this oxidation process gradually and quietly, and it does so by producing certain substances called *enzymes* or *ferments*.

Enzymes.—Our knowledge of enzymes is confined almost entirely to a recognition of their action. They act powerfully in minute quantities. They are not used up in the process. A given enzyme acts only on one particular substance, or perhaps on a small group of similar substances. The action may be to break down a complex substance into simpler ones, or from simple substances to build up a complex one.

Digestive System.—The digestive system or alimentary tract is a long tube beginning at the mouth. From here the masticated food passes down the œsophagus or gullet into the stomach, where it remains for some time subjected to the digestive action of the gastric juice. It then

enters the small intestine, in which the digestive process is completed; the resulting products are absorbed into the blood, and the useless residue passes on into the large intestine, finally leaving the body by the rectum. The passage of food along the tube is effected by the rhythmic contraction and relaxation of the muscular fibres in its wall.

The digestive juices are formed in small glands in the mucous membranes lining the tract, but important aids are afforded by the *liver* and the *pancreas*, two glands which pour their secretions into the commencement of the small intestine.

Excretion.—The breaking down processes of metabolism result in the production of various waste products, just as a fire produces ashes. These waste products must be removed, because they tend to clog the mechanism, and many of them, besides, are injurious to the body. The process of disposal is called *excretion*. The chief channels by which they leave the body are (1) the kidneys, which form the urine; (2) the intestine, which gets rid of waste matters in the feces; (3) the lungs, which give off carbon dioxide; (4) the skin, which forms the sweat.

Circulatory System.—The products of digestion are distributed to all parts of the body by the *circulatory system*. This consists of a central pump, the *heart*, with muscular walls which contract rhythmically. It is divided into two halves, a left and a right. The left heart forces the blood through a series of branching channels, the *arteries*, which form a network all over the body. Other channels, the *veins*, carry the blood to the right heart. The blood on its return is pumped through the lungs, to be aerated before passing to the left heart and being again distributed to the body.

Respiratory System.—The lungs are contained in the chest, and air is forced in and out by the action of special muscles. The air comes into intimate contact with the blood circulating through the lungs, and oxygen is taken up and carried to the tissues. The great waste product of metabolism, carbon dioxide, is carried by the blood to the lungs, and there it passes out into the air. Thus the blood arrives at the lungs charged with carbon dioxide, and leaves them charged with oxygen.

Blood.—The blood, therefore, supplies the whole body with food and with oxygen. Its oxygen-carrying power is due to a pigment called *hemoglobin*, contained in myriads of tiny cells floating in the fluid part of the blood. There are also cells which act as scavengers. They play an important rôle in maintaining health by attacking and eating up the organisms which produce disease.

Receptors.—It is essential for an organism that, in order to survive, it should be capable of

adapting itself to changes in its surroundings. The range of adaptation depends partly on the capacity to receive impressions from external changes. Such changes are called *stimuli*, and in the higher animals special organs are set aside for their reception. These organs may be designated in the most general terms as *receptors*, but the most important are commonly known as the special sense organs. Thus we have the eye responding to light, the ear to sound, &c.

Effectors.—The animal provided with the most elaborate receptor organs for appreciating changes in its environment would derive little benefit if it was unable to respond to those changes. Consequently the development of the receptor system has been accompanied by that of mechanisms for reacting to external changes. This *effector system*, as we may call it, consists of the muscles. Skeletal muscle is attached to the bones, and enables the animal to perform movements. Visceral muscle is found in the internal organs, and controls their action.

Nervous System.—With advances in the development of receptors and effectors, it becomes necessary to avoid the conflict of dissimilar reactions to different stimuli, and desirable that reactions should be carried out speedily. This leads to the formation of connecting-links between receptors and effectors, which, increasing in complexity, come to constitute the *nervous system* and to dominate all the other systems in the body. These links consist of specialized cells with long branching processes. The whole cell forms a *neuron*, and the nervous system is built up of vast numbers of these units. The separate neurons are brought into functional continuity by the close approximation of their processes, but there is no structural continuity. This conception forms the basis of modern views regarding the action of the nervous system.

In the higher animals the nervous system may be divided into two parts: a central part, consisting of the *brain* and *spinal cord*; and a peripheral part, consisting of the *nerves* linking the various organs to the central part. Impulses travelling along the nervous system are divided into *afferent*, or those passing towards the centre, and *efferent*, or those passing towards the periphery.

The spinal cord acts as a central exchange, sorting out the incoming messages from the receptors and the outgoing messages to the effectors, and carrying them to their various destinations. In the spinal cord impulses from receptors may be directed along outgoing channels to effectors, and give rise to what are known as *reflex actions*, i.e. actions in which consciousness is not involved.

The spinal cord expands at the head end into the brain. At its base are various sub-stations

concerned with the control of such vital processes as circulation and respiration. The *cerebellum* or lesser brain controls muscular co-ordination and equilibrium. But the height of nervous development is reached in the brain proper or *cerebrum*. Here we have the seat of consciousness, of willed actions, of memory and intellectual processes. In man the cerebrum surpasses in development that of any other animal. Apart from its relatively enormous size, its outer layer or *cortex*, consisting of innumerable nerve-cells, is very thick, and is thrown into folds or convolutions which greatly increase its area. This elaborate convolution is a distinctive feature of the human brain, and the advance in complexity from savage to civilized man is readily perceptible.

Endocrinetes.—There is a small group of glands which pour their secretions directly into the blood, and are therefore called the ductless glands or *endocrinetes*. Although many of them are of minute size, their action is of such importance in regulating the general metabolism that any departure from normal function produces serious and often fatal results.

Reproduction.—In order to provide for the continuation of the species, certain cells are grouped to form reproductive organs.

The foregoing description gives, however imperfectly, some idea of the multifarious processes at work in the human body. Physiology, regarded purely as a science, is concerned with nothing else, but the physiologist's studies correlate the normal with the abnormal. Hence physiology is also the foundation of medicine. To understand the departures from the normal which constitute disease, the physician must be acquainted with the normal. He is constantly employing his knowledge of physiology, and every advance therein furnishes him with additions to that knowledge and with new weapons for his struggle with disease.

Phytolac'ca, a genus of tropical or sub-tropical herbaceous plants, type of the nat. ord. *Phytolaccaceæ*. One species is the American pokeweed.

Phytophthora, a genus of Fungi, family *Peronosporaceæ*. *P. infestans* is the potato-blight, one of the worst diseases of the potato, though not so deadly now as during the first decade of its ravages in Europe (1840-50). The disease shows itself first in the form of brown patches on the leaves; these spread, the leaves curl and decay, and in severe cases the entire haulm may blacken and rot in a few days. The mycelium of the fungus lives in the intercellular spaces of the shoot, but sends forth fertile branches through the stomata into the air, bearing numerous little oval conidia that spread the infection, especially in warm, damp weather,

since each conidium produces a number of actively swimming zoospores if it falls into a drop of water. The mycelium finally spreads to the tubers, which may also, when young, be directly infected by zoospores, and either causes them to rot or more often hibernates in them and starts the disease afresh if infected tubers are planted as 'seed'. The best preventive remedies are destruction of infected plants and planting of 'seed' from a non-infected crop of one of the varieties least susceptible to the disease; an attack that has started may be checked by spraying the foliage with Bordeaux mixture.

Piacenza, pyā-chen'tsa, a province of Emilia, North Italy, belonging to the basin of the Po. Area, 967 sq. miles; pop. 267,000.

Piacenza (ancient *Placentia*), a city of North Italy, capital of the province of Piacenza, at the confluence of the Trebbia with the Po. Being a place of strategic importance, it has long been fortified, and is still surrounded by walls with bastions and fosse, outside which is a series of detached forts. The principal edifices are the cathedral, in the Lombard-Romanesque style (mostly built between 1122 and 1233), and other churches; the town house (Palazzo Comunale), of the thirteenth century, one of the finest structures of its kind; and the Palazzo Farnese (now used as barracks). Piacenza is an important railway centre. The manufactures consist of cotton goods, woollens, stockings, hats, and leather, and there are also several silk-spinning and paper-mills. Pop. 40,360.

Piacenza was originally a Roman colony, founded in 219 B.C. Between 997 and 1035 it was governed by its bishops. In 1447 it was captured and sacked by Francesco Sforza; and in 1545 it was united with Parma to form an hereditary duchy for Pierluigi Farnese, son of Pope Paul III.

Piana dei Greci (pyā'ná de-i-grā'chē), a town of Sicily, in the province and 10 miles s.s.w. of the city of Palermo. Silks and woollens are manufactured. Pop. 8500.

Pianoforte. Musical instruments in general may from one point of view be divided into two classes: those which have come down to us from early times with little or no alteration of their original form, and those which in their present shape are the result of a gradual evolution. Of the former the trombone is the outstanding example, while among the more numerous members of the second class the organ and the pianoforte take a prominent place. The reason for this will be apparent when it is remembered that these two instruments are dependent for their perfection on a highly elaborate mechanism, and their rate of progress has therefore inevitably been conditioned by the rate of advance in mechanical ingenuity. It would be unwise to

say that either the organ or pianoforte is now in its final state. Indeed, the pianoforte has quite recently (1922) taken a new and very important step onward, as will be shown later in this article.

The pianoforte is the latest and most popular representative of a large class of stringed instruments which derive their tone from a momentary excitation of the strings, in contrast to those of the violin class, in which the making of sound by means of the bow is a continuing process. The ultimate ancestor of the pianoforte is the psaltery. This ancient instrument was in its essentials merely a simple form of the dulcimer, being held in the hand or hung round the neck, while the strings were sounded by the fingers or by a plectrum instead of by hammers, as in the case of the true dulcimer. There are many highly appreciative references to it in early writings, and Chaucer, in the *Miller's Tale*, makes mention of it in the familiar lines:

And all above ther lay a gay sautrie
On which he made on nightes melodie,
So swetely, that all the chambre rong,
And *Angelus ad virginem* he song.

The spinet and harpsichord are a direct development from the psaltery, and, with the clavichord, are the prototypes of the pianoforte. The spinet, which is really only the oblong form of the harpsichord, was, like the latter, a very favourite instrument in its day, particularly in England, where it was more commonly called the virginal or virginals. Some lexicographers have derived this alternative name from the fact that "maids and virgins do most commonly play on them", but it is much more probable that the instrument was so named because of its use in accompanying the *Angelus ad Virginem*; for, as it is interesting to note, it followed its parent, the psaltery, in the performance of this worthy office.

The harpsichord, which, it should be remembered, includes the spinet and virginal, was during the sixteenth, seventeenth, and eighteenth centuries as universally popular as the pianoforte is to-day. It was the instrument that Bach and Handel played and wrote for, and they preferred it to the newer pianoforte, which was just becoming known in the days of their prime, and was still largely in the experimental stage. The tone production in the harpsichord was effected by means of *jacks*, little wooden uprights placed on the end of the keys opposite to that touched by the performer. At the top of the jacks was fixed a point or plectrum made of crow quill or hard leather, which was forced past the wire by the descent of the key, and in its passage plucked or twanged the wire into sound. The mechanism was therefore no more than an elaborated application of the plectrum principle, and sound gradations were entirely beyond the immediate

control of the player. The tone was brilliant but lacking in delicacy, and so short-lived that all kinds of embellishments were in use in harpsichord music to give a semblance of rhythmic vitality and continuity of sound. The instrument was generally made with two keyboards, and provided with stops, by means of which changes from loud to soft could be made and even a limited amount of tone contrast introduced. The case of a harpsichord was very often embellished with fine paintings done by contemporary masters, and with appropriate mottoes, such as *Sic transit gloria mundi*, in which an obvious reference is made to the short-lived nature of music in general and of harpsichord tone in particular.

The clavichord, the other immediate predecessor of the pianoforte, differed from the harpsichord in one or two important details. In its mechanism the plectrum-like quill or piece of hard leather was replaced by a small wedge or tangent of brass about an eighth of an inch broad at the top. When the key was put down, this tangent rose to meet the string and, pressing against it, set it in vibration. Further, by remaining in contact with the wire it fixed the vibrating length of the latter, and so decided the pitch of the resulting sound. The method of tone-production in the clavichord was therefore based on that of the monochord with moveable bridge, from which, indeed, it was directly derived. The instrument also differed from the harpsichord in its tonal results. They were delicate and charming, suggesting a kind of diffidence which sensitive musicians found very agreeable. By means of the tangent the player could feel himself in much more intimate association with the string than was ever possible while playing the harpsichord, and a good performer on a good instrument could even secure variations of tone-amount, and had the high pleasure of controlling these variations directly through his manner of using the key. It was also possible to repeat a note several times without quitting the key, with a charming effect which was not possible on the harpsichord and cannot be obtained from the pianoforte. It was indicated by the German word *bebung*, and Beethoven has introduced an imitation of it in one of his latest sonatas, Op. 110 in A flat. He had a great admiration for the clavichord, because of its powers of tone-control and expressive interpretation. Mozart also played the instrument, and it was a favourite with the great Bach and his son Emanuel. If we regard the harpsichord and the clavichord as the parents of the pianoforte, then they might be said to stand in the relation of father and mother respectively.

The aim of the first makers of pianofortes was to combine the good features of the harp-

sichord and the clavichord. The former could give brilliance and speed of execution, but could only vary the tone-amount by artificial means, which included the use of swell shutters on the organ principle. The latter could give great sweetness of tone and delicate variations of tone-amount, but could only be heard in a small space, and was therefore quite useless for public performance. It was also seriously lacking when sparkling *staccato* effects were required. In connection with the actual invention of the pianoforte, the usual conflicting claims are met with. France, Germany, and Italy are competitors for the honour, but the fullest investigation has clearly established the right of Italy to the distinction. She therefore provides in this matter one more example in music of her power to originate and her inability to bring to perfection, for Italy at the present time does not harbour any of the great centres of pianoforte-making. Bartolommeo Cristofori (1651-1731) was the name of the inventor of the pianoforte. He was a harpsichord-maker of Padua, who removed about 1687 to Florence, where, in 1711, he produced the first of the new instruments. It is significant that during the eighteenth century the new invention was as often called *fortepiano* as *pianoforte*. This indicates clearly that the name was given to distinguish it from all other instruments of its class by means of its special feature—the power to give soft or loud tones at the will of the performer; and it was this power which Cristofori had decided to make the goal of his endeavours.

His first step was to replace the tangent of the clavichord with the hammer, the idea for which he took from the dulcimer. But a serious difficulty at once confronted him. It will be remembered that the tangent of the clavichord remained in contact with the string as long as the key was held down; and while this was an essential part of the instrument's mechanism, it had a damping effect upon the tone, which has been well described as a 'blocking' of the sound. Cristofori saw that it would be necessary in his new instrument to provide some means whereby the hammer, after setting the wire in vibration, could fall back, even though the key were still depressed, and leave the wire in perfect freedom to continue sounding. There is no means of knowing how long it took him to solve this problem, but in devising the contrivance called the 'hopper' he provided a complete solution; in a greatly improved form it is still one of the main features of the pianoforte mechanism. The hopper is actuated by the key, and rises as the latter is put down, in the manner of the jack in a harpsichord. At its upper end it is in contact with the under surface of the hammer-shaft, which therefore rises with it and moves the

hammer-head towards the wire. Before this journey to the wire is completed, the hopper, owing to the construction of the mechanism, slips out of contact with the hammer-shaft and returns to its first position, leaving the hammer free to fall back into its original place as soon as its act of tone-making is finished. (It should be understood that the details of the above description are only applicable to the actions of grand pianos; but the main principle is the same in all classes of instruments.) It is not too much to say that, in solving this initial difficulty, Cristofori had made the pianoforte possible.

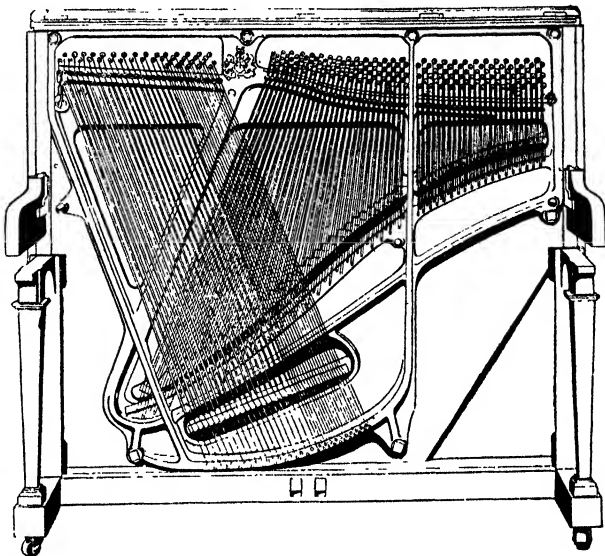
There were still many other serious problems to be solved, but they only arose after Cristofori had so cleverly devised the hopper. He is entitled to much honour in this connection. Any readers who desire to follow the development of the pianoforte through all its stages may be recommended to read the standard works on the subject given at the close of this article. For present purposes it will suffice to point out that the blow from the hammer in the newly invented instrument was more than the wire in general use at that period could stand. The introduction of heavier wire caused a greatly increased strain on the framing, which had in consequence to be greatly strengthened, a seemingly simple matter which waited a long time for a satisfactory solution. Many constructional problems arose from time to time of a less fundamental nature which were solved with varying success, such as the best material for wires, the most effective form of damper and of

damper action, the most effective point on the vibrating string for the hammer to strike, &c. Indeed, the pianoforte-makers of to-day are still experimenting, and, where a delicate and elaborate mechanism like that of a modern instrument is concerned, there will no doubt always be some points on which the inventive mind will joyfully exercise itself.

It will not be necessary to give a detailed description of the pianoforte. It is probably the best-known of all instruments, and there are few homes without a specimen. The proportion of really worthy instruments in this host of pianofortes is not so high as could be wished, and there are many households in which this most willing and serviceable of music-makers is less looked after than any other piece of domestic furniture. Perhaps a wider knowledge of its qualities and merits will lead in time to a more

sympathetic understanding of its very modest needs; it will then be more difficult than it is now to find a piano that is hopelessly out of tune, or has some notes which do not sound or some keys which will not rise after they are played, or pedals which do not act.

The great value of the instrument for music and musicians lies in its sensitive response to the touch of the player and its power to render complete harmony. Through the wonderfully delicate action the pianist while playing is in the most intimate connection with the wires,



Pianoforte

A view of the interior—keyboard and hammers removed. By permission of Messrs. John Broadwood & Sons, Ltd.

and the expressive quality of his performance, supposing he has a good instrument, is entirely his own. Any defects in the instrument mean a loss of sensitiveness, and the player is immediately handicapped. On the harmonic side the pedals play a vital part; indeed, without them the piano would not have established itself as a serious musical instrument. Yet it is perhaps on this point that the greatest ignorance prevails. The right-foot pedal when pressed down raises all the dampers at once, so that the wires, after being set in vibration, continue to produce sound either until the dampers are again brought into action by allowing the pedal to rise or until the sounds die off of themselves. By means of this pedal, therefore, many more notes can be made to sound simultaneously than would be possible by means of the hands unaided by the pedal. Further, while the damper-pedal is depressed *all*

German armies under General Otto von Below (Fourteenth Army) were divided into four 'groups', and successfully attacked the left wing and centre of the Italian Second Army (24th Oct., 1917, a.m.). Although only a local victory, the crisis came when the troops driven out of the Caporetto-Tolmino sector got out of control and, in their disordered retreat, carried back the concentrating detachments of reserves. On 25th Oct. (p.m.) General Capello proposed to General Cadorna an immediate retreat to the line of the Tagliamento. The Second Army had now completely crumbled, and the breach was widening dangerously when Cadorna gave the order for a general retreat to the Piave in order to shorten his line (26th Oct., p.m.). Five of the



eight army corps which composed the Second Army had already been almost completely disintegrated, and it was obvious that the Tagliamento was no longer a suitable line on which to make a stand. By Saturday, 27th Oct., the whole Italian line was in full retreat. In May, 1916, Cadorna had given orders for the construction of suitable defences on the mountain ridges between the Brenta and Piave, and to the north-east of Asiago. To this line the Italians retreated in hopeless confusion.

First Battle.—General Cadorna was superseded by General Diaz and a new Italian High Command, and an Allied mission (Mr. Ll. George, MM. Painlevé and Barthou, and Generals Smuts, Foch, Henry Wilson, and Robertson) hastened to Italy. Affairs had become serious. On 10th Nov., 1917, the enemy engaged the Italian Fourth Army on the Middle Piave. It was a feeler, and a general battle immediately developed. The Italian positions were maintained.

Second Battle.—In March, 1918, four French and two British divisions were rushed from Italy to reinforce the Allied armies in France, on account of the collapse of the British Fifth

Army during the German offensive. The Italian 2nd Corps was also drafted, and Diaz then commanded 50 Italian and 5 Allied divisions, as against 60 Austrian divisions which had been completely reorganized while in winter quarters. On 15th June the Austrians advanced to exterminate the Allied army, and concentrated mainly astride the Oderzo-Tréviso Railway. Although immediately held up, they succeeded in establishing three bridge-heads across the Piave, and made some local gains, to which the closely knit defensive system of the Italian army held them as in a vice. The Piave rose in flood, and after a week of terrible battling the Austrians were compelled to withdraw.

Third Battle.—Their failure in June, 1918, killed the last vestige of Austrian hopes for 'peace by victory'. Their enormous losses had shaken their moral, and the Italian High Command immediately grasped their advantage. But their own losses and the fact that the reinforcements were already tired precluded the idea of an immediate Italian advance. "The planned offensive had to aim at assisting the general effort of the Allies . . . to drive the attack home with all available forces . . . to obtain a real superiority of forces . . . and to gain a decision at one blow" (Diaz). In the west the successful advances of the French were followed by the savage onslaught of the British armies (8th Aug., 1918). The Italians had now 51 Italian, 3 British, 2 French, 1 Czechoslovak divisions, and 1 United States infantry regiment—827 battalions, supported by 7000 guns and trench mortars. At three o'clock on the morning of 24th Oct. (anniversary of Caporetto disaster) the battle commenced between the Brenta and the Piave; at 7.15 a.m. the infantry advanced, and the battle raged until the 27th, when the Italians succeeded in establishing three bridge-heads on the Piave. On the 30th the Austrian line crumbled, and by 1st Nov. the Italians had reoccupied the line of the Tagliamento.

Piazza-Armerina, a city of Sicily, in the province of Caltanissetta, and 18 miles E.S.E. of the town of Caltanissetta. Wines, oil, and nuts are traded. Pop. 25,000.

Pibroch (pē'broh; Gael. *piobaireachd*, art of playing the bagpipe), a wild, irregular species of music peculiar to the Highlands of Scotland. It is performed on a bagpipe, and adapted to excite or assuage passion, and particularly to rouse a martial spirit among troops going to battle. The pibroch produces by imitative sounds the different phases of a battle—the march, the conflict, the flight, the pursuit, and the lament for the fallen.

Pic'ardy, one of the pre-Revolutionary provinces of France, in the northern part of the country, lying between the English Channel, Normandy, and Artois, now divided among the departments of Pas-de-Calais, Somme, Aisne, Oise, and Nord. The capital was Amiens.

Picaresque Novel, *The*, a type of fiction dealing with the adventures of rogues (Sp. *pícaro*, a rogue). The prototype of this kind of novel is the *Satiricon* of Petronius Arbiter, which describes the disreputable adventures of Encolpius, Ascyltos, and Giton in Cumæ and neighbouring towns. There is a certain picaresque element in the *Golden Ass* of Apuleius, where, in addition to stories of witches and magic, there are also tales of brigands and rascals. Some passages of Lucian describe the adventures of some quite pronounced rogues. But as a definite branch of literature the picaresque novel originated in Spain with the publication of *Lazarillo de Tormes* in 1554. This novel may be said to mark an epoch in literature, as it dealt with everyday life as opposed to chivalry and romance. For some while Spain was the home of the rogue-novel, some of the most remarkable being Mateo Aleman's *Guzman de Alfarache* (1599); *La Picara Justina* (1605), which recounts the adventures of a female rogue, and which may have suggested Moll Flanders to Defoe; *Marcos de Obregon* (1618); and Quevedo's *Vida del Buscón* (1626). Two of the *Novelas Ejemplares* of Cervantes (published 1613) also treat of roguery. The picaresque novel soon made its way to England. The credit of writing the earliest one in English belongs to Thomas Nash, who published *The Unfortunate Traveller: or The Life of Jack Wilton* in 1594. Some of Defoe's work must be classed as picaresque, especially *Moll Flanders* and *Colonel Jack* (both published 1722). To France, however, belongs the crowning glory of the picaresque novel. Scarron's *Roman comique* (1651) and Furetière's *Roman bourgeois* (1666) show picaresque tendencies; but in *Gil Blas de Santillane* (1715) Le Sage crystallized and intensified all the most attractive features of the rogue-novel. Le Sage's originality has been attacked, and it is true that he drew much of his material from Spanish sources, but in the proper sense of the word he is as original as most great writers. His influence is plainly to be seen in the work of several great English novelists. Fielding seems to have followed Cervantes rather than Le Sage, but his *History of Mr. Jonathan Wild the Great* (1743) is a picaresque novel. Smollett wrote several books which may fairly be classed as picaresque novels, especially noteworthy being *Ferdinand Count Fathom* (1753). Dickens carried on some features of the Smollettian tradition, especially in his early work; *Pickwick* (1837) and

Oliver Twist (1838) are perhaps better classed as peripatetic novels, but the latter devotes a considerable amount of space to thieves and roguery. Thackeray's *Barry Lyndon* (1844) portrays a fairly complete rogue. *The Adventures of Hajji Baba of Ispahan*, published by James Justinian Morier in 1824, is a very amusing and clever example of a rogue-novel. Sir Walter Scott reviewed it for the *Quarterly*, and referred to the hero as the Oriental Gil Blas, thus showing that he did not shrink from comparing it with the greatest of all picaresque novels.—**BIBLIOGRAPHY**: F. W. Chandler, *Romances of Roguery*; F. M. Warren, *History of the Novel previous to the Seventeenth Century*; Sir Walter Raleigh, *The English Novel*.

Piccini (pit-ché'nē), Niccolo, Italian musical composer, born in 1728, died in 1800. He composed comic and serious operas, chiefly for the stages of Rome and Naples, with such success that for many years he was without a rival in Italy. In 1776 he accepted an invitation, on very favourable terms, from the French court, and went to Paris, where he engaged in the famous musical contest with Gluck. In his later years he fell into misfortunes. He wrote over 150 operas, besides numerous oratorios and cantatas.

Pic'colo, an instrument of the flute family, used in orchestras and military bands. The name is the Italian word for 'little', and the full name of the instrument is *flauto piccolo* or little flute. It is half the length of the flute, and therefore sounds an octave higher than the latter, and its fingering and technique are exactly the same. It has a working compass of two octaves and a sixth, with D for the lowest note and B flat for the highest in the case of the orchestral piccolo. Two more semitones are possible at the top of the compass, but are too little under control and too unpleasant in effect to be of any practical value. Owing to its high pitch and somewhat colourless quality of tone, it is not so generally useful as the flute, but for its own special effects no other instrument could take its place. It is a favourite with most composers, and they gladly avail themselves of its services on appropriate occasions.

Piccolom'ini, a noble Siennese family, still flourishing in Italy in two branches. The two most celebrated members are: (1) Æneas Sylvius Bartholomæus, afterwards Pope Pius (Pio) II (q.v.). (2) Octavio, a grand-nephew of the first, born in 1599, died in Vienna in 1656. He was one of the distinguished generals of the Thirty Years' War, was a favourite of Wallenstein, and fought at Lutzen (1632). He participated in the plot which resulted in Wallenstein's assassination. He took part in the battle of Nördlingen, and was then sent to the Netherlands, where he

remained till 1648. In 1650 he was created a prince and duke of Analfi.

Pic du Midi, a name given to more than one summit of the Pyrenees, as the Pic du Midi de Bigorre, or Bagnères (9440 feet), and the Pic du Midi d'Ossau (9465 feet).

Pice (pis), a small Indian copper coin, value about one farthing sterling. It is subdivided into three *pies*.

Picea. See *Norway Spruce*.

Pichegru (pêsh-grü), Charles, French general, born at Arbois, department of Jura, 1761, died in 1804. For some time a tutor at the College of Brienne, he soon exchanged this profession for that of a soldier. Commander-in-Chief of the army of the Rhine in 1793, and of the army of the north in 1794, he subjugated Holland, and entered Amsterdam in Jan., 1795. Disgusted with the anarchical state of affairs then prevailing in the capital, he entered into negotiations with the Bourbons, and became the soul of the party hostile to the Revolution. Transported to Cayenne in 1797, he escaped to England, where he entered into a conspiracy with George Cadoudal to assassinate Napoleon. Having gone to Paris for this purpose, he was captured by the police, and committed to the Temple prison, where he was found strangled.

Pichinch'a, a volcano of Ecuador, in the Western Cordillera, north-west of Quito; height, 15,900 feet.

Pichincha, a province of Ecuador. Quito is the capital. This province, with a pop. of 205,000, is the most densely peopled area of the Republic.

Pi'cidæ, the woodpecker and wryneck family, so named from the chief genus, *Picus*. See *Woodpecker*.

Pick'ere, the American name for some of the smaller kinds of pike.

Pickering, an urban district and town of England, in North Riding of Yorkshire; a railway junction on the North-Eastern system. It is a town of great antiquity. Its castle was the prison of Richard II in 1390. Pop. 3700.

Pickles, food-stuffs preserved in vinegar or brine. In early times in agricultural countries the farmers killed at Michaelmas the cattle which were to be used as food during the winter, and preserved the flesh by the use of this process. In those days winter vegetables were few and pickled vegetables were in extensive use. The processes of pickling are different, to some extent, for each type of food-stuff. Olives, capers, walnuts, and similar articles are preserved for use as appetizers in a simple solution of salt or brine. Cucumbers, green tomatoes, onions, cauliflowers, and other vegetables are cleaned, cut to size, and subjected to boiling vinegar, with which they are allowed to simmer for some time.

After the process is completed the pickles are bottled. Sauerkraut is cabbage cut fine and allowed to ferment in its own juice and salt. There is a considerable trade in pickled fish, especially herrings, for the German, Scandinavian, and Russian markets. Pickled mackerel is a popular dish with the poorer part of the population of America. Meat is pickled with solutions of mixtures of common or rock-salt, more or less sugar, some saltpetre, and such things as coriander seeds, dried bay leaves, garlic, &c. To ensure effective pickling, some of the solution is filtered or siphoned, so that it is quite clear, and is then injected into the meat by the use of a hand-pump and a sharp-pointed nozzle.

Pico, a Portuguese island in the Atlantic, forming one of the Azores group. It consists of a single volcanic mountain, which terminates in a peak (El Pico) 7613 feet high. Wine and oranges are produced. Area, 175 sq. miles; pop. 25,000.

Picric Acid, a yellow crystalline substance, $C_6H_2(NO_2)_3O$, obtained by the action of nitric acid upon phenol and its allied compounds. It is of a very poisonous nature. Its salts, the picrates, explode when struck or heated, and are used as explosives. Other uses to which this substance is put are small in extent compared with its use as an explosive, but it is also used as a dye and in relieving the pain of burns in industrial works.

Picton, Sir Thomas, British soldier, born in Pembrokeshire 1758; entered the army in 1771, and, after serving in the West Indies, rose to the rank of colonel, and became Governor of Trinidad in 1797. His next service was the capture of Flushing, of which he was appointed Governor in 1809. He afterwards distinguished himself in the Peninsular War at Badajoz, Vittoria, Ciudad Rodrigo, &c. He was killed at Waterloo in 1815.

Pictou, a seaport and port of entry of Nova Scotia, Canada, on the Intercolonial Railway. Coal is mined and largely exported, and there are other industries. Pop. 3500.

Picts. When Agricola invaded Scotland, the chief native tribe was known as the Caledonians. In the fourth century the Caledonians had become a division of the Picts. The tribal name of the Caledonians afterwards dropped out of use. The first Roman reference to the Picts dates from A.D. 297. By the fourth century Scotland, formerly called Caledonia, was known as Pictland, Pictavia. Evidently the Picts had become the dominant people, and the overlords of the aboriginal Britons of the north, who were called in Gaelic the Cruithne, the Q-Celtic rendering of the P-Celtic Prydein (Britons). There were Cruithne in Ireland also. Cruithne should not be translated 'Picts' but 'Britons'. In Old Welsh the Picts were called *Peithwyr* (Pictmen).

a name derived from Pect, the Old Scots form of which is Pecht (or Peght, as used by Sir Walter Scott in *The Pirate*). Celtic scholars reject the derivation of the tribal name from the Latin *pictus*. "Pecti", writes Professor W. J. Watson, "cannot be separated etymologically from Pictones, the name of a Gaulish tribe on the Bay of Biscay. . . . Their name shows the same variation between Pict-ones and Pect-ones. We may therefore claim Pecti as a genuine Celtic word." Apparently the Pictones colonized Orkney and Shetland. The Gaelic evidence shows that the Picts were divided into two sections, called the Orcs (young boars) and the Cats. Orkney was known as Inse Orc ('Isles of Boars') and Shetland as Inse Catt ('Isles of Cats'). The people of Caithness (Cathness) and of Sutherland are still known in Gaelic as the 'Catach', and the Duke of Sutherland is 'Diuc Chat' ('Duke of the Cats'). The Norsemen called the sea between the islands and the mainland *Pettaland-fjordhr*, i.e. Pictland Firth, now Pentland Firth. In the *Irish Book of Ballymote* it is stated that "Cairneach was for seven years in the sovereignty of Britons and Cats and Orcs and Saxons". The Picts are associated in tradition with the brochs which so closely resemble the *nuraghi* of Sardinia. These brochs are most numerous in the north. On the west they are distributed as far south as Wigtownshire, and on the east as far south as Berwickshire. The Pictish skiffs were large, open boats with twenty oars a side, painted a neutral tint, the sails being dyed in the same colour. It is believed that the Picts turned Hadrian's Wall from the sea. Their allies on the west were the Dalriadic Scots, and on the east they appear to have co-operated with 'Saxons' before the close of the Roman period. Claudian (fourth century) refers to Theodosius attacking Picts and Saxons in Orkney and Thule (Shetland), and Scots in Ireland (*De Quarto Consulatu Honorii*, line 31). The Pictish capital was at Inverness in the middle of the sixth century, and it was in his palace on the banks of Loch Ness that St. Columba found King Brude, the Pictish king, and was successful in converting him to Christianity. In the ninth century the Picts and Scots were united under King Kenneth macAlpin, whose mother was a Pict. See *Scotland*; *Strathclyde*.—BIBLIOGRAPHY: W. F. Skene, *Celtic Scotland* (vol. i) and *Highlanders of Scotland* (vol. i); W. C. Mackenzie, *Races of Ireland and Scotland* (with a bibliography).

Picus, an old sylvan deity in Italy, who was represented with the head of a woodpecker (Lat. *picus*), and presided over divination.

Pidgin-English (Chinese corruption of 'business English'), a language used in the ports of

China and elsewhere in the East, as also on the coast of West Africa, as a medium of communication between natives and foreigners. Occasionally it is used as a lingua franca by the natives themselves hailing from different districts and speaking various dialects. Pidgin-English consists of monosyllabic English words and an admixture of Malay, Portuguese, Chinese, and miscellaneous words of many languages.

Piedmont (It. *Piemonte*), a department of Italy, between Switzerland, Lombardy, Liguria, and France, and divided into the provinces of Alessandria, Cuneo, Novara, and Torino. Area, 11,331 sq. miles; pop. (1915), 3,508,626. It forms the upper valley of the River Po, and derives its name, signifying 'foot of the mountain', from its situation at the base of the loftiest ranges of the Alps, by which it is enclosed on all sides except towards the Lombard plain. Maize, rice, wine, olives, oil, nuts, hemp, and silk are produced. Minerals include salt, coal, copper, lead, and silver. The chief town is Turin. See *Sardinia*; *Savoy*, *House of*; *Italy*.

Piepowder Court, or **Plepoudre Court** (O.F. *piepoudreux*, pedlar, dusty foot), a court formerly set up at fairs and markets in England for the summary administration of justice in cases arising there. It is also called the Court of Dusty Foot, which has the same meaning as piepowder. It was the lowest court of justice, and was so called from the circumstance that the litigants were usually tradesmen who travelled from one fair or market to another.

Pier. See *Jetty*.

Pietermaritzburg, a city of the Union of South Africa, capital of the province of Natal; served by railway from Durban. It was founded in 1843, and named after the Boer leaders Pieter Retief and Gert Maritz. It has wide streets planted with trees, and contains the Governor's residence; Government buildings; fine town hall (1901), with large organ; two cathedrals; and a college. Pop. (1921), 38,690, 17,000 being coloured.

Pietism, a term often applied in derision to ill-regulated religious excitement and mysticism, or to a devotional attitude. Like 'Methodist', the term Pietist was originally bestowed in contempt. More strictly, however, it was the name given to the religious views of a group of Lutheran reformers in Leipzig, who began in 1689 to deliver ascetic lectures on the New Testament to the students and citizens. The idea of imparting theological instruction in a popular way came from their friend and teacher Spener (the German Fénelon), who had held religious meetings in Frankfurt from the year 1670, at which the laity prayed and were allowed to ask questions. The Leipzig lectures were put a stop to as being hostile to good government, but the influence of

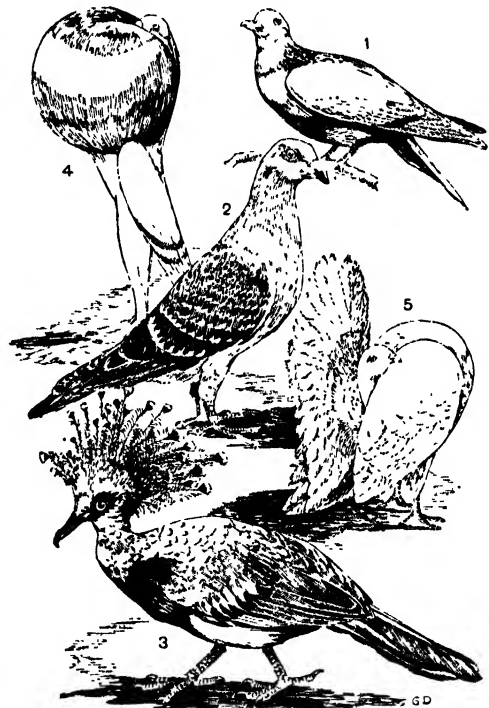
the Pietists led to the foundation (1695) of the University of Halle, which became the centre of evangelical religion in Germany. The leading adherents of Spener were appointed its first professors, among them Francke, the founder of the celebrated Waisenhaus or orphanage at Halle. The Pietists were noted for their preference for practical as opposed to doctrinal religion, but they never formed a separate sect. The Jansenism and Quietism of France, and the Methodism of England, sprang from sources similar to those of the German pietism.—Cf. A. Ritschl, *Geschichte des Pietismus*.

Piezom'eter (Gr. *piezo*, I compress), an instrument used by Oersted for measuring the compressibility of liquids. A tall, thick-walled glass vessel with a layer of mercury at the bottom is filled up with water. The vessel is closed by a strong brass cap bored centrally, and fitted with a water-tight screw piston, by means of which pressure is applied to the water. The liquid to be compressed is contained within a glass bulb provided with a long capillary neck, and the bulb is immersed in the water of the vessel with the mouth of the capillary tube opening under the mercury. A tube containing air also opens under the mercury, and acts as a pressure gauge. On screwing down the piston the rise of the mercury in the capillary indicates the compression of the liquid, and if the volumes of the bulb and tube are known, the compressibility of the liquid can be determined. For water and mercury, within certain limits, the decrease of volume is proportional to the increase of pressure; also, liquids regain their original volume on removal of the pressure, liquids being in this respect perfectly elastic. The compressibility of water is 1 part in 22,000 per atmosphere of pressure, that of mercury 1 part in 270,000.

Pig, or **Hog**, when used in the broadest sense, the name of omnivorous animals belonging to the swine family (Suidæ) of even-toed, non-ruminating hoofed mammals. They are small or of moderate size, and possess a flexible snout, used for rooting in the ground and ending in a bare disc perforated by the nostrils. The feet are four-toed, though the small outer toes do not reach the ground, except in swampy places, where they serve as 'stops' to check sinking-in. Swine are widely distributed through most parts of the Old World, but are replaced in America by the peccaries, which belong to a distinct family (Dicotylidæ). The type genus is *Sus*, and of this the most familiar species is the wild boar (*S. scrofa*), abundant in many parts of Europe and Asia, and formerly native to Britain. The closely allied Indian wild boar (*S. cristatus*) is the one that figures in 'pig-sticking' exploits. A small species of pig (*S. andamanensis*) is native to the Andaman Islands,

and the pygmy hog (*S. salvaniana*) lives in the forest regions on the south of the Himálaya. Other species range through Malaya as far east as Celebes, and still others are found in New Guinea and Japan. The Senaar pig (*S. senaarenensis*) is native to North-Eastern Africa. Other African swine are the red river hogs (species of *Potamochoerus*) and the wart hogs (species of *Phacochoerus*), the latter possessing enormous tusks and curious knobs on the face. The Babyroussa (*Babirusa*) is peculiar to Celebes, and is distinguished by the scantiness of its hair and extremely long, upwardly curved tusks in both jaws. —BIBLIOGRAPHY: R. Lydekker, *Royal Natural History*; F. E. Beddard, *Mammalia* (Cambridge Natural History Series); Sanders Spencer, *Pigs: Breeds and Management*; British Breeds of Livestock (Ministry of Agriculture); W. Fream, *Elements of Agriculture*; articles in *Standard Cyclopædia of Modern Agriculture*.

Pigeon, the common name for many members of a family of birds (Columbidæ) also including



Pigeons

1, Stock-dove. 2, Homing or Racing Pigeon (Blue Chequer). 3, Victoria Crowned Pigeon. 4, Pouter. 5, White Fantail.

the doves. The upper mandible is arched towards its apex, and of horny consistence; a second curve exists at its base, where there is a car-

tilaginous plate or piece through which the nostrils pass. The crop is of large size. Pigeons are generally strong on the wing. They are mostly arboreal in habits, perching upon trees, and building their nests in elevated situations. Both sexes incubate; and these birds generally pair for life, the loss or death of a mate being in many cases apparently mourned and grieved over, and the survivor frequently refusing to be consoled by another mate. The song consists of the well-known plaintive *cooing*. The pigeons are distributed in every quarter of the globe, but attain the greatest luxuriance of plumage in warm and tropical regions. The pigeon family is divided into various groups. The true pigeons or Columbinae are represented by the stock-dove (*Columba oenas*) of the southern English counties, which has been credited with being the progenitor of the domestic pigeon. The ring-dove or cushat (*C. palumbus*) is the largest British species, and has a wide distribution. The rock-dove (*C. livia*) forms the species from which the various domestic varieties have sprung. The house-pigeons, tumblers, fan-tails, pouters, carriers, and jacobins are the chief varieties of the rock-pigeon, and have been employed by Darwin (*Origin of Species and Animals under Domestication*) to illustrate many of the points involved in his theory of 'descent by natural selection'. The turtle-dove (*Turtur communis*), found in Britain in summer, is also a representative species. Other forms are the Treroninae or fruit-pigeons of India, the Eastern Archipelago, and Australia; and the Gourinae or ground-pigeons, the largest of the group, including the crowned pigeon (*Goura coronata*) of the Eastern Archipelago. See *Carrier Pigeon*; *Passenger Pigeon*; *Turtle-dove*; &c.

Pigeon-pea, the fruit of the leguminous shrub *Cajanus indicus*, a native of India, but now cultivated in tropical Africa and America. In India the pigeon-pea forms a pulse of general use. Called also *Angola Pea* and *Congo Pea*.

Pig-farming. The commonest British pigs and their characteristics are as follows:

Large White.—White in colour; long and deep carcass; ears long and inclined forward. *Objections*.—Blue spots on skin; coarse, pendulous ears; heavy jowls; coarse skin and hair; black hairs.

Middle Whites.—Same as Large White excepting ears, which should be erect and smaller.

Berkshires.—Black in colour, with white blaze on face, white tip to the tail, and white feet; ears erect. *Objections*.—Narrow forehead; short snout; heavy jowls; thick, coarse, or much inclined (forward) ears; white or rusty patches of hair.

Large Blacks.—Black in colour, with long, thin ears covering the eyes and snout.

Tamworths.—Golden-red in colour; long snout; pricked ears. *Objections*.—Black hairs; black spots on skin; drooping ears; upturned snout.

Lincolnshire Curly-coated.—White in colour; curly hair; long, thin ears covering eyes and snout.

The commercial pig of to-day, wherever bred, is a descendant of the wild hog, which at one time was common in Britain. As definite breeds, the English pigs have been evolved within the last seventy years, chiefly by a judicious crossing with Neapolitan and Chinese varieties, and at the present day all, without exception, of the improved pigs in the world owe both their increased size and their quality to one or more of the above varieties. There are now no known varieties in any country which can compete with British native breeds, even including those American pigs which practically owe their existence to them. Ireland, although a great pig-breeding country, has no breed of her own; in Scotland pigs are not generally popular, and no effort is made to popularize them, so that English breeds dominate the world, and nowhere is it possible to find pigs that are able to bear comparison with such standard breeds as the Large White, which is not only most popular in Britain, but has been used more extensively than any other variety for the improvement of pigs abroad. It possesses, when at its best, all the qualities which are calculated to produce an abundance of fine meat and to repay the breeder and feeder for his pains. It was freely used by the Danes in building their great bacon industry, as well as by the Germans, French, and Americans. The Large White is a prolific, hardy pig of good constitution and even temper, of a shape adapted to the production of the most useful sides of bacon, and such as can be modified to meet the requirements of the curer or pork-butcher. The sows are good dams, producing large litters of strong pigs which grow with great rapidity. At all ages they are good growers and good feeders, making the most of their food, and producing soon after weaning 1 lb. of live weight for 4 lb. of good meal. Any of the Whites, Large, Middle, or Small, are good for the breeder, and as such can be recommended.

Management.—Of all domesticated animals the pig has the least care and attention bestowed upon it, and it seems to be a commonly accepted opinion that any inexperienced person may keep and breed good pigs. Pig-feeding and management is a difficult art, of which the mastery can only be obtained by a long, practical apprenticeship, combined with a certain amount of theoretical study. The domestic pig is by nature as cleanly an animal as the ewe or the mare, and it is mainly due to misconception and care-

lessness that 'pig' has become synonymous with 'filth', in which all pigs are absurdly supposed to benefit by wallowing. Certain factors have contributed greatly to the neglect of the pig, but one of them is markedly outstanding, namely, that the pig appears to possess the power of making great progress under conditions of gross neglect, and this progress is not infrequently so great as considerably to benefit the neglectful owner. Again, a pig matures within a much shorter period than any other domestic animal, the average being only seven months. The sow also possesses remarkable powers of multiplication and reproduction, as many as thirteen piglings being bred in one year by a sow, as compared with the single annual calf of the cow, or foal of the brood mare.

Mating.—Care must be taken in the choice of a sow for breeding purposes, and also in the boar for mating, as the male tends to impart a large proportion of his character to the offspring, particularly when a pure-bred boar is mated with a mongrel. The age prescribed for a female pig to be mated with the boar varies between six and twelve months, but if she has been fairly well reared and the probable time of year of her farrowing will prove suitable, she may be served when eight months old. A young sow should farrow in the early part of March, as the young pigs will naturally thrive better in spring than at any other season, and the sow will regain her strength and complete her growth better in the summer than during the winter months. There is a marked difference in the prolificacy of sows, as there is also in their capacity to produce a quantity of rich milk extending over a period of at least eight weeks. It is not always advisable to leave on the sow the whole of a large litter which she may produce, and although a matured and judiciously fed sow will have no trouble in rearing as many as twelve pigs, the exact number allowed to remain has never been authoritatively fixed. Two of the principal drawbacks to allowing a young sow to rear a large litter of pigs are the loss of flesh and the check to the growth and development of the dam that invariably ensue.

Feeding.—Opinions differ as to the best method of feeding pigs at varying ages, but the following is recommended by Sanders Spencer, the well-known pig-breeding expert. "The sow pigs intended for breeding purposes are usually weaned when about six weeks old. The best single food for sows suckling their litter, and also for the latter when weaned, is the offal from the grinding of wheat, known variously as 'sharps', 'middlings', or 'thirds', &c., according to district, whilst the best addi-

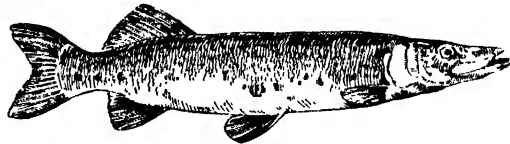
tion to this is skimmed milk, where procurable, then separated milk, buttermilk, and whey, all in comparatively small quantities, fed at first through the sow, but subsequently, when the pigs are a few weeks old, mixed with their food. Indigestion and constipation attack the youngsters where much separated milk is fed, and this can only be remedied by the addition of some oil or fat, which unfortunately proves on occasion too rich for the immature digestive organs of the little pigs. When they are from three to four months old, barley-, oat-, pea-, or wheat-meal may generally be added to the sharps fed, until at five months of age the meal automatically becomes the staple food, with an occasional dose of milk in small quantity. During spring and summer, tares, clover, lucerne, and cabbages, or other greenstuffs, materially assist the fattening process; and in winter, mangold, turnips, swedes, and kohlrabi, &c., take their place. Save for potatoes, cooked vegetable food is neither economical nor beneficial."

The weight at which pigs should be sold depends solely upon the demands of the market they are reared to supply. — Cf. *Live-stock of the Farm* (vol. v), editor, Professor C. Byrner Jones.

Pigments. See *Paints and Pigments*.

Pika, the calling-hare (*Lagomys*), an animal nearly allied to the hares, and forming the family *Lagomyidae*. It is found in Russia, Siberia, and North America, and is remarkable for the manner in which it stores up its winter provision, and also for its voice, the tone of which so much resembles that of a quail as to be often mistaken for it.

Pike, a genus of fishes belonging to the ord. Teleostei, and included in the soft-finned division



Pike (*Esox lucius*)

of the order. The pikes form the types of the family *Esocidae*, in which group the body is lengthened, flattened on the back, and tapering abruptly towards the tail. One dorsal fin exists, this structure being placed far back on the body, and opposite the anal fin. The lower jaw projects. Teeth are present in plentiful array, and are borne by almost every bone entering into the composition of the mouth. The common pike (*Esox lucius*) occurs in the rivers of Europe and North America. It is fished chiefly for the sake of its flesh, which is accounted exceedingly

wholesome. The pikes are very long-lived, and form the tyrants of their sphere, being the most voracious of freshwater fishes. When fully grown, the pike may attain a length of 5 or 6 feet, and there are numerous instances on record in which these fishes have greatly exceeded that length. The sea pikes (Belone), also known as gar-pikes (see *Gar-fish*), and the saury pike (*Scomberesox saurus*) belong to a different family (Scomberesocidae). The bony pike (Lepidosteus) of North American lakes and rivers belongs to a widely different order. See *Bony Pike*.

Pike, a sort of lance, a weapon much used in the Middle Ages as an arm for infantry. It was from 16 to 18 feet long, and consisted of a pole with an iron point. For some time every company in the armies of Europe consisted of at least two-thirds pike-men and one-third harquebusiers. Gustavus Adolphus omitted the pike-men in some regiments entirely. The invention of the bayonet about 1690 drove the pike out of use.

Pike-perch (Lucioperca), a genus of fishes closely allied to the perch, but showing a resemblance to the pike in its elongated body and head. Like the pike, it is a dangerous enemy to other freshwater fishes, but the flavour of its flesh is excellent. In Europe it occurs in two species. It also occurs in the fresh waters of North America, such as the Great Lakes, the Upper Mississippi, and the Ohio.

Pike's Peak, a peak of the Rocky Mountains, in the centre of the state of Colorado, United States. It was discovered by Lieutenant Z. M. Pike in 1806, and was first ascended by a party under Major S. H. Long (1819). A rack-rail line of railway, 9 miles long, runs to the top of the mountain, upon which a powerful search-light is stationed.

Pilaster, a square pillar projecting from a pier or a wall to the extent of from one-fourth to one-third of its breadth. Pilasters originated in Grecian architecture. In Roman they were sometimes tapered like columns, and finished with capitals modelled after the order with which they were used. See *Column*.

Pilate, Pontius, Roman procurator of Judæa (A.D. 26-36). Nothing is known of his early history. He was a narrow-minded and impolitic governor, and at the very beginning of his term of office commotions arose among the Jews at

Jerusalem. When Christ had been condemned to death by the Jewish priests, who had no power of inflicting capital punishments, He was carried by them to Pilate to be executed. Yielding to the clamours of the Jews, the Roman governor ordered Jesus to be executed, but permitted Joseph of Arimathea to take His body and bury it. Philo speaks of Pilate as an obstinate and merciless man, but from the Canonical Gospels he appears to have been possessed of a sense of justice, and stress is laid upon the fact that he made a serious effort to acquit Christ. Pilate was afterwards removed from his office by Vitellius, prefect of Syria (A.D. 36), and, according to tradition, was banished by Caligula to Vienna (Vienne), in Gaul, where he is said to have died or committed suicide some years after.—Cf. Matt. xxvii, 2, 11-27; Luke iii, 1; xxiii, 1-25, 50-52.

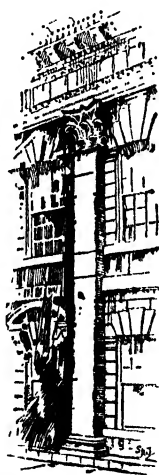
Pila'tus, a mountain mass of Switzerland, on the borders of the cantons of Lucerne and Unterwalden. Its loftiest peak, the Tomlishorn, attains a height of 7116 feet. It is almost as great a favourite with mountain climbers as the Rigi, on account of the imposing views of the Bernese mountain scenery obtained from various points. A railway to the summit was opened in 1889.

Pil'chard (*Clupea pilchardus*), a species of fishes included in the family and genus of the herrings (Clupeidae), which they much resemble though rather smaller. They frequent the coasts of Britain all the year round. The usual spawning time is October. They are found in greatest plenty on the southern coasts of England, the Cornwall pilchard fisheries being those best known and most celebrated. Pilchards are chiefly consumed in Spain, Italy, and France during Lent and other fasting seasons. Many of the commercial 'sardines' are in reality young pilchards. See *Sardine*.

Pilcoma'yo, a river of South America, which rises in Bolivia, on the eastern declivities of the Andes, and falls into the Paraguay, near Asunción, after forming the boundary between Paraguay and the Argentine Republic. Its entire length is between 1500 and 1600 miles. The Pilaya and the Paspaya are the principal affluents.

Piles. See *Foundation*.

Pilgrimage of Grace, an insurrectionary movement in 1536-7, consequent upon the proceedings of Henry VIII in regard to the Church. The movement arose in Lincolnshire, and then spread to Yorkshire. The insurgents demanded the fall of Cromwell, redress to the Church, and reunion with Rome. Mustering to the number of 30,000, the rebels, under Robert Aske, Lord Darcey, and Sir Robert Constable, marched upon York, and within a few days were masters of England north of the Humber. Henry temporized, promising a free Parliament at York;



Pilaster, Greenwich Hospital

but when the insurgents returned home all concessions were revoked, and a renewal of the revolt was suppressed with great rigour. Many perished by the block, the gibbet, and the stake.

Pilgrim Fathers. The foundation of the first British Empire (i.e. of the empire as it existed before 1783) was closely connected with religious divisions in England and the refusal of toleration to Nonconformists by James I. Elizabethan efforts to found colonies on the eastern coast of North America had been unsuccessful, but a settlement was made in Virginia in 1609, and it attracted the attention of a body of Puritans, belonging to Scrooby and Gainsborough, who had fled from England to Holland. They entered into negotiations with a London Company to which the Virginia Company had ceded some of its rights, and obtained permission to found a colony near the mouth of the Hudson River. The English Government put no obstacles in the way, and the exiles sailed from Delftshaven in July, 1620. They called at Southampton, from which, on 5th Aug., 120 of their number sailed for America in the *Mayflower* and the *Speedwell*. The last-named vessel was compelled to return as unseaworthy, but about 100 left Plymouth on 6th Sept. in the *Mayflower*. They reached the coast of North America in December, but stress of weather prevented their making for their intended destination at the mouth of the Hudson, and they landed in the region of Cape Cod, where they founded the colony of New Plymouth, as "loyal subjects of our dread sovereign, King James" (21st Dec., 1620). Before landing they had drawn up a written constitution for the new colony, agreeing to form themselves into a 'body politic', and promising due obedience to laws which they were to draw up. They suffered many hardships on their arrival, and about half their number died in the first winter. The dangers by which they were surrounded led them to try a short-lived system of having all things in common. The London Company, which had permitted their settlement near the Hudson, made difficulties about the position of the new colony, and the colonists were unable to bring their democratic constitution—government by the whole body of freemen—into operation until 1627. By that date they had received small accessions to their numbers, which were greatly increased after the grant of a charter to the Massachusetts Company in 1629. The name 'Pilgrim Fathers' is sometimes loosely used for all the settlers up to 1629 and even later, but it properly belongs to the emigrants in the *Mayflower*.—**BIBLIOGRAPHY:** A. Ames, *The Mayflower and her Log*; B. M'Manus, *The Voyage of the Mayflower*.

Pilgrims (O.Fr. *pelegrin*; Fr. *pèlerin*; Lat. *peregrinus*, foreigner), persons who visit distant places, considered sacred, for religious purposes. The practice of making pilgrimages to places of peculiar sanctity is as ancient as it is widespread. The ancient Egyptians and Syrians had privileged temples, to which worshippers came from distant parts. The chief temples of Greece and Asia Minor swarmed with strangers. But it is in Christianity and Mahommedanism that the practice has attained its greatest development. The first Christian pilgrimages were made to the graves of the martyrs. By the end of the fourth and the beginning of the fifth century the custom had become so general as to lead to abuses. Throughout the Middle Ages, and especially about the year 1000, the religious fervour of the people manifested itself in numerous pilgrimages, especially to Jerusalem. The outrages inflicted on the Christian pilgrims by the Saracens led to the Crusades, which were themselves nothing else than gigantic armed pilgrimages. The shrine of Our Lady of Loretto, near Rome, that of St. James of Compostella in Spain, of St. Martin of Tours in France, were all sacred spots to which, from the tenth to the thirteenth century, and even much later, pilgrims resorted in innumerable crowds; and from the end of the twelfth century the shrine of St. Thomas Becket at Canterbury had the same honour in England. Other places of pilgrimage in England were St. Albans, Walsingham, Lichfield, Bury St. Edmunds, and Peterborough. The pilgrims usually wore a broad hat, grey or black cloak, and carried a long staff. A bottle or bell was the badge of pilgrims from Canterbury, whilst a string of scallop shells was that of pilgrims from Compostella. Palmers were pilgrims who had completed a pilgrimage to the Holy Land and had carried away a palm leaf. After the Reformation the practice of making pilgrimages fell more and more into abeyance, and the spirit which led to it seems almost to have become extinct among Christians, although there are still occasional outbursts of it among the Roman Catholics, as in the modern pilgrimages to Paray-le-Monial, Lourdes, Iona, and Holy Island. In the Greek Church, Mount Athos is the chief shrine of pilgrimage. For Mahommedans the great place of pilgrimage is Mecca, which was the resort of Arabian pilgrims long before the time of Mahomet. Every year just before the feast of Bairam large caravans arrive at Mecca from all quarters. The pilgrims who join these caravans have in view not only the performance of a religious duty, but also the object of doing some business. Among the Hindus and the Buddhists also the practice of performing pilgrimages largely prevails. The principal resorts of pilgrims in India are the

sacred city of Benares, the rock-cut temples of the Island of Elephanta, the pagoda of Juggernaut, and the temple of Ellora.—BIBLIOGRAPHY: J. Jusserand, *English Wayfaring Life in the Middle Ages*; J. C. Wall, *Shrines of British Saints*.

Pilibhīt, a district and town in the Bareilly division of the United Provinces, India. The district lies close to the Himālaya, and is a plain watered by the Sarda River and by the Rohilkhand canals. The Oudh-Rohilkhand Railway (Lucknow-Bareilly section) traverses the district. Area, 1350 sq. miles; pop. about 480,000. The town of Pilibhīt stands on the Desha River. In 1740 it was seized by the Rohilla leader Hāfiz Rahmat Khān, who made it his capital. In the western outskirts stand his cathedral-mosque and the remains of his palace. Pop. 33,000.

Pillau (pil'ou), a seaport of East Prussia, at the entrance of the Frisches Haff. Large vessels for Königsberg may be partially unloaded at Pillau, which is connected with Königsberg by the Königsberg Ship Canal, dredged to a depth of 20 feet. The railway from Lyck through Königsberg has its seaward terminus at Pillau, which is thus connected direct with Bialystock, on the Warsaw-Moscow line. After the opening of the ship canal Pillau lost much of its importance, but has still two docks and can accommodate vessels of 1500 tons. The Pillau Deep is a fortified channel protected by moles, and forms an entrance 328 yards wide and 27 feet deep (minimum) to the Frisches Haff. It is kept open in winter by ice-breakers. Pop. 4000.

Pil'ory, a frame of wood erected on posts, with movable boards, and holes through which were put the head and hands of a criminal for punishment. In this manner persons were formerly exposed to public view, and generally to public insult. It was a common punishment in Britain for forestallers, users of false weights, those guilty of perjury, forgery, and libel. After 1637 restrictions were put upon the press, and the pillory became the punishment of all those who had printed books without licence or published seditious writings. The punishment was abolished in 1816 in all cases except that of perjury, and it was abolished altogether in 1837. The pillory was used in Germany and France, and was in use in the United States till 1839.

Pilobolus, a remarkable genus of Zygomycetous Fungi, allied to Mucor. *P. crystallinus* regularly appears on horse-dung. Each sporangium is borne on a stout, erect hypha (sporangioophore), 1 to 1½ inches high, which swells up into a club-shaped bulb at its upper end. The osmotic pressure inside this bulb is very great, and when the sporangium is ripe, it is thrown bodily to a considerable distance by the sudden bursting of the bulb. The mass of spores is sticky, and adheres to any object

it may strike, normally a blade of grass or other herbage; if it is swallowed by a horse, the spores pass unharmed through the alimentary tract and germinate in the dung. The sporangioophore is very sensitive to light (positively heliotropic; see *Heliotropism*), and Buller has shown that the bulb, besides serving to disperse the spores explosively, also acts as a light-perceiving sense-organ. This curious fungus is readily obtained for observation by keeping some fresh horse-dung under a bell-jar for about a week.

Pilocarpidine, an alkaloid (C₁₀H₁₄N₂O₂), occurring along with pilocarpine (q.v.) and isopilocarpine in *Jaborandi*.

Pilocarpine, an alkaloid obtained from the dried leaves of *Pilocarpus pinnatifolius*, a South American plant of the ord. Rutaceæ (rue). It is a very powerful drug, and acts as an antidote in cases of poisoning by belladonna. See *Jaborandi*.

Pilot, a person qualified to navigate a vessel within a particular district. The pilots of the United Kingdom are formed into associations at different places by ancient charters of incorporation, or by particular statutes. The principal of these associations are the Brotherhood of Trinity House of Deptford Strond; the Fellowship of the Pilots of Dover, Deal, and the Isle of Thanet, or the Cinque Port Pilots; and the Trinity Houses of Hull and Newcastle. The Trinity House of Deptford Strond regulates the pilotage of the Thames and Medway, and of the coast from Orfordness to the Isle of Wight; besides which it is entrusted with the general regulation and superintendence of pilotage for the United Kingdom. (See *Trinity House*.) The law relating to British pilots and pilotage is contained in various Acts. By the existing law, oversea vessels must employ a pilot in those parts of the voyage where a pilot is employed by regulation or usage. A master refusing to take a pilot vitiates the insurance on the vessel; while a pilot refusing to perform the duty for which he is licensed renders himself liable to penalties. The master or owner of a vessel is not responsible for damage caused by the fault or incapacity of any qualified pilot, where the employment of such pilot is compulsory; but the pilot must not be interfered with in the discharge of his duties. Pilotage fees depend on the distance and the draught of water of the vessel piloted. Masters and mates passing the requisite examination are entitled to pilotage certificates to conduct their own vessels.

Pilot-fish (*Naucrætes ductor*), a genus of Teleostean fishes included in the Carangidæ or horse-mackerel family. The pilot-fish was formerly supposed to act as a pilot to the mariner, and is still supposed to act as such to sharks. It often follows in the wake of ships for long distances, associating with sharks and devouring the refuse thrown overboard. The average

length is about 12 inches. In general form it resembles the mackerel.

Pilsen, or **Plzen**, a town and railway junction of Western Bohemia (Czecho-Slovakia), at the confluence of the Mies and Radbusa. It consists of the town proper, with promenades on the site of the old ramparts, and of three suburbs. The principal buildings are the church (1292) and town house. The chief article of manufacture and commerce is beer. The second town of Bohemia, Pilsen dates from 1272, but is mentioned as early as 976 as the scene of a battle between Boleslas and the Emperor Otto II. During the Thirty Years' War it was for a time the head-quarters of Wallenstein. Pop. 81,100.

Pilsudski, Joseph, Polish soldier and statesman, was born at Zulov, in the province of Vilna, in 1867. His intense patriotism early found him disfavour in Russian eyes, and he was exiled and imprisoned on various occasions prior to the European War. On the outbreak of war he invaded Russia at the head of a Polish legion (6th Aug., 1914), and became a member of the Polish Council of State when the Austro-German conquest was complete. When the State of Poland was recreated, he became head of the Provisional Government, and became President on 20th Feb., 1919, by popular election. He led the Poles to the invasion of the Ukraine in July, 1920. See *Poland*.

Pilularia (pillwort), a genus of water-ferns, family Marsileaceæ (q.v.).

Pimelo'dus, a genus of cat-fishes (Siluridæ), found in South America, and supposed to abound in subterranean lakes, as one species (*P. cyclopum*).



Scarlet Pimpernel (*Anagallis arvensis*) in Fineand in Cloudy Weather

Pim'pernel (*Anagallis*), a genus of plants belonging to the nat. ord. Primulacæ. The *Anagallis arvensis*, or field pimpernel, a beautiful annual, is commonly known in England (where the scarlet-flowered variety is by far the most

common) as the 'shepherd's or poor man's weather-glass', from the fact that its flowers do not open in rainy weather. The bog pimpernel (*A. tenella*) grows in the drier parts of marshes in England. The blue and lilac varieties of the *A. collina*, originally a native of South Africa, have been introduced into gardens in Great Britain, where they have a fine effect. The water pimpernel is the *Veronica Anagallis*; the yellow pimpernel, *Lysimachia nemorum*.

Pin and Pin Manufacture. The domestic pin was introduced during the fifteenth century. Prior to that time fastenings of a very primitive type were used, but even during the Bronze Age the pins of brooches were carefully made and finished. A statute of 1483 prohibited the importation of pins from the Continent, and sixty years later an Act prohibited the sale of pins unless made "double-headed", or with heads "fast soldered to the shank". The industry was mainly developed in France, and despite all regulations and enactments French pins were sold in the British markets. They were expensive, which made 'pin-money' a serious consideration for the ladies. Tilsby introduced pin-making into Gloucestershire in 1626, but little progress was made in this industry during the next two centuries. In 1817 Seth Hunt patented a machine for the manufacture of pins in which head, shaft, and point were fashioned from the one piece, but little use was made of this invention. Wright designed a machine in 1824 which was later developed by Shuttleworth and Tyler, who made improvements in pin-making quite comparable with those Mason made in pen-making. The old processes of manufacture, which Adam Smith described as an example of the division of labour, have been entirely superseded by the use of machinery, not only to make the pins, but also to stick them in rows in the paper in which they are sold.

In the modern pin-making machine the wire from a coil is first straightened by being drawn through a series of steel pins or stops. The end is passed through a hole in a small steel anvil, and is then hammered until the head is formed. A tool then parts the pin-blank from the rest of the wire, and the operation is repeated. The blanks, with the heads uppermost, fall into slanting grooves, and are guided between revolving files, which shape the points. The pins fall into a box, and are finished by tinning. The paper on which the pins are to be mounted is passed between corrugated wheels to form the waves in it. The pins are brushed into a number of grooves and fall forward. At the end of the journey through the grooves, a steel plate is made to

come down over the pin-heads and force the pins into the paper, which is fed forward to a suitable position for the purpose. A movable steel arm prevents any but the first row of pins from being pressed into the paper until the proper time. Hair-pins are made by first cutting the suitable lengths of wire, which pieces are fed forward in guides, and later caught between a pair of movable steel jaws which move downwards. During this action the wire is pressed inwards from each side by means of wheels, whose distance apart can be regulated to suit the dimensions required. When the wire has to be waved, the wheels are made with suitable corrugations on their edges.

Pina Cloth, or **Pina Muslin**, a costly fabric made in Manila from the unspun fibres of the leaves of the cultivated pineapple plant (*Ananas sativus*). Its colour is almost white, but has a slight tinge of yellow in it. In spite of the delicacy of its texture it is remarkably strong. Its chief use is for making ladies' pocket handkerchiefs, light dresses, and similar articles. It is frequently adorned with exquisite embroidery.

Pinar' del Rio, a town and province of Cuba. The town is situated 90 miles by railway from Havana, in the famous Vuelta de Abajo, where the best tobacco grows. Pop. 10,000.—The province has an area of 5200 sq. miles; pop. 250,000. It raises some of the world's finest tobacco; sugar, coffee and fruits; timber, and cattle are also produced.

Pinchbeck, an alloy containing about 80 per cent of copper and 20 per cent of zinc, used as a substitute for bronze and for making cheap watch-cases and imitation jewellery. By association the word is used to indicate anything spurious, counterfeit, or cheap. It is named after the inventor, a London watchmaker of the eighteenth century.

Pindar (Pindaros), the greatest lyric poet of Greece, was born about 522 B.C. and died 443 B.C. He belonged to a noble Theban family, which liked to trace its descent back to Cadmus. He is said to have studied at Athens under Apollodorus and Lasus of Hermione, and he was always a lover of the Athenians, who eventually made him honorary consul, and presented him with a large sum of money. Pindar began to write poetry when young; the technique of his branch of poetry was difficult to master, and he served a long apprenticeship. Little is known of the events of his life, but it is made clear not only by tradition but by his writings that he was a deeply religious man. His reputation was very great both during his life and after his death. There is a well-attested story that when Alexander the Great sacked Thebes in 335 B.C. he ordered it all to be de-

stroyed save the citadel, the temples, and Pindar's house. This story is alluded to in Milton's well-known sonnet *When the Assault was intended to the City*.

Pindar wrote lyric poetry of all kinds—hymns, pæans, dithyrambs, processional songs, choral songs for maidens, dance-songs, encomia, drinking-songs, dirges, and odes of victory. With the exception of the last class, all these poems are lost or are only represented by inconsiderable fragments. The *Epinicia* (Odes of Victory) consist of forty-four odes arranged in four books: (1) Olympian odes, fourteen odes for the winners of the wild olive wreath in the Olympian games, held at Olympia in honour of Zeus once in four years; (2) Pythian odes, twelve odes for winners of the laurel wreath in the Pythian games, held at Delphi in honour of Apollo once in four years; (3) Nemean odes, eleven odes for winners of the pine wreath in the Nemean games, held at Nemea in honour of Zeus once in two years; and (4) Isthmian odes, seven odes for winners of the parsley wreath in the Isthmian games, held in the Isthmus of Corinth once in two years. Pindar's odes are distinguished by their great boldness of diction, their daring use of simile and metaphor, their poetical inversion of the natural order of words, and their audacious coining of new words. The main portion of each ode consists of a myth more or less closely connected with the victor's city or family; the ode closes by alluding to the victor's good luck or good guidance. The religious element is very prominent, as is the poet's elevated and austere morality, which had as its central idea the theory that acquired excellences were of no importance in comparison with native temperament. Pindar is a magnificent poet, and serves to link the Homeric epos to the Athenian drama. He is the most Homeric of all the lyric poets known to us, and yet has some of the qualities that go to make a great dramatist.—**BIBLIOGRAPHY:** (Editions) B. L. Gildersleeve, *Olympian and Pythian Odes*; J. B. Bury, *Nemean and Isthmian Odes*; (Translations) E. Myers, *Extant Odes of Pindar*; C. Mayne, *Olympian Odes*; (Criticism) F. D. Morice, *Pindar* (Ancient Classics for English Readers Series); A. Croiset, *La poésie de Pindare, et les lois du lyrisme grec*.

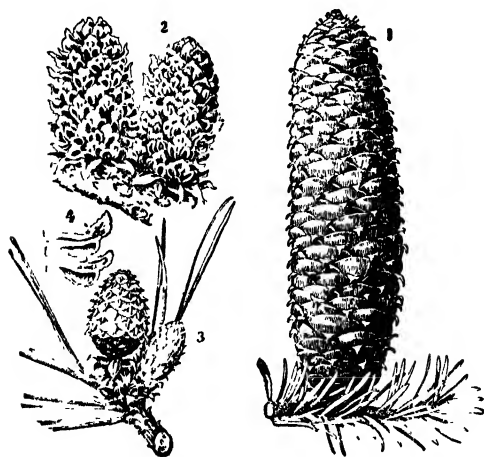
Pindaris (that is, *freebooters*), a name given to the marauding companies of mounted robbers which remained in force after the fall of the Mogul Empire. They were descended mostly from the caste of Mahomedan warriors, which formerly received high pay from the Indian princes, and they were secretly excited by the Indian tributaries to attack the Company. Between 1804 and 1816 they became not only dangerous to English rule, but were also the terror of the native population. In 1817 Hast-

ings, the British Governor-General, determined on the destruction of these robbers, whose force was estimated at 40,000 horse. Attacked on all sides, they were conquered and dispersed. Garrisons were placed in some fortresses, and the native states of the infested district were formally taken under British protection.

Pind Dadan Khan, a town in the Jhelum district of the Punjab, India. It stands on the Jhelum River, and is served by the Sind-Sāgah branch of the North-Western Railway. There is a trade in salt. Pop. 11,000.

Pindus, the ancient name of the principal mountain range of Northern Greece, forming the watershed of the country and the boundary between Thessaly and Epirus. It was, like Helicon and Parnassus, a seat of Apollo and the Muses.

Pine, the popular name of trees of the Coniferous genus *Pinus*, family *Pinacæ*, which is divided



1, Fir Cone (*Abies pectinata*). 2, Pollen-bearing Flowers of Mountain Pine (*Pinus montana*). 3, Female Flowers of Mountain Pine. 4, Polliniferous scales of Mountain Pine.

into two sections, namely, (1) *Abietinæ*, the fir tribe; and (2) *Cupressinæ*, the cypress tribe. The pines belong to the former section, and are distinguished from the spruce, larch, fir, cedar, &c., chiefly by having persistent leaves in clusters of two to five on short shoots borne in the axils of membranous scales. All the European species, except *P. Cembra*, have only two leaves in a sheath; most of the Asiatic and American kinds have three or five leaves. The cones also afford an important ready means of distinction and classification. The Scots pine or fir (*P. sylvestris*) is a tall, straight, hardy tree, from 60 to 100 feet high; a native of most parts of Europe, flowering in May and June, and having many varieties. The leaves are rigid, in pairs, some-

what waved and twisted; the lower branches are somewhat pendant; the bark is of a reddish tinge, sometimes rough and furrowed. The leaves are distinguishable from those of all other pines in which they occur in pairs by their glaucous hue, especially when young. The Scots pine almost always occurs in masses; it is considered full grown and fit to be cut down for timber in fifty or sixty years; but in the north of Scotland, where pine forests grew to perfection in former times, the tree continued to increase in bulk for three or four centuries. The tree is most abundant in the north of Europe, between lat. 52° and 65°. There are extensive forests of it in Russia, Poland, Sweden, Norway, Germany, the Alps, the Pyrenees, and the Vosges. In Scotland it grows at the height of 2700 feet on the Grampians. The Corsican pine (*P. Laricio*) grows to a height of from 80 to 100 feet, and in the Island of Corsica it is said to reach an altitude of 140 to 150 feet. The pinaster, or cluster pine (*P. pinaster*), is indigenous to the south of Europe, to the west of Asia, the Himalaya, and, it seems, even to China. It is a large, handsome, pyramidal tree, varying from 40 to 60 feet in height. Its cones point upwards, in star-like clusters, whence the name of pinaster or star pine. In France, especially between Bayonne and Bordeaux, it covers immense tracts of barren sand, in which it has been planted to prevent the sand from drifting. The stone pine (*P. pinæ*) is a lofty tree in the south of Europe, where it is a native; its spreading head forms a kind of parasol; the trunk is 50 or 60 feet high, and clear of branches. In Britain the stone pine seldom exceeds the size of a large bush, although specimens have reached a height of 30 and 40 feet. Sabine's pine (*P. Sabiniæna*) was discovered in California in 1826. The leaves are in threes, rarely in fours, from 11 to 14 inches long; the trees are of a tapering form, straight, and from 40 to 120 feet high, with trunks from 3 to 12 feet in diameter. The Arolla pine (*P. Cembra*) is a native of Switzerland and Siberia. The red Canadian pine (*P. resinosa*), or yellow pine, inhabits the whole of Canada from the Atlantic to the Pacific, and is also found in the northern and eastern parts of the United States. The trunk rises to the height of 70 or 80 feet, by about 2 feet in diameter at the base, and is chiefly remarkable for its uniform size for two-thirds of its length. The wood is yellowish, compact, fine-grained, resinous, and durable. The true yellow pine (*P. variabilis*) rises to the height of 50 or 60 feet, by 15 or 18 inches in diameter at base. The cones are small, oval, and armed with fine spines. The timber is largely used in shipbuilding and for house timber. The Labrador or Banks's pine (*P. Banksiæna*) is usually a low straggling tree, growing among barren

rocks to a height of from 5 to 8 feet, but may attain three times that height. The cones are recurved and twisted; and the leaves are regularly distributed over the branches. In Nova Scotia and the state of Maine it is known as the scrub pine, and in Canada as the grey pine. The other American pines are the Jersey pine (*P. inops*), the trunk of which is too small to be of any utility in the arts; the pitch pine (*P. rigida*), which is most abundant along the Atlantic coast, and the wood of which, when the tree grows in a dry, gravelly soil, is compact, heavy, and contains a large proportion of resin; the loblolly pine (*P. taeda*), the timber of which decays speedily on being exposed to the air; the long-leaved pine (*P. palustris*), also called yellow pine and pitch pine, which abounds in the lower parts of the Carolinas, Georgia, and Florida, furnishing resin, tar, pitch, and turpentine, and most excellent timber; the Weymouth pine (*P. strobus*), the timber of which, though not without essential defects, is consumed in much greater quantities, and for a far greater variety of purposes, than almost any other; and Lambert's pine (*P. Lambertiana*), which grows between the fortieth and forty-third parallels of latitude, and about 100 miles from the Pacific. It is of gigantic size, the trunk rising from 150 to upwards of 200 feet, and being from 7 to nearly 20 feet in diameter.

Pine'al Body, in anatomy, is a body, about the size and shape of a cherry-stone, attached to the roof of the brain-stem. It represents the remains of a median eye found in certain reptiles and lowlier vertebrates. It was considered by the ancients to be the seat of the soul.

Pineapple (*Ananas sativus*), a plant belonging to the nat. ord. Bromeliaceæ, much esteemed for its richly flavoured fruit, which somewhat resembles a pine-cone. A native of tropical America, it is now naturalized in many hot countries, is also cultivated in hot-houses, and is imported in quantities into Britain, the United States, &c. The plant yields the fibre of which pina cloth (q.v.) is made. The fibre is used for textile purposes in China, and to some extent in India, and it is believed that in the latter country the fibre might easily come to be of commercial importance.

Pine-chaffer, or **Pine Beetle** (*Ilyesinus pini-perda*), a species of beetle which infests Scots pines. It feeds on the young shoots of these trees and eats its way into the heart, thus converting the shoot into a tube.

Pine-finch, or **Pine-grosbeak** (*Pyrrhula enucleator*), a perching bird belonging to the finch family (Fringillidæ). It is of larger size than its near relative the common bullfinch, and measures from 8 to 9 inches in length. It occurs in the Arctic and northern regions of

both Old and New Worlds. It is more rarely found in the temperate portions of Europe.

Pinel', Philippe, French physician, born in 1745 at St. André, died in Paris 1826. He studied at Toulouse and Montpellier, and in 1791 came into notice by his treatise *Sur l'aliénation mentale*. In the following year he was made directing physician at the Bicêtre, and in 1794 at Salpêtrière. By his writings and by his management of these two asylums, in which he introduced the humane treatment of the insane, Pinel laid the foundations of the great reform that has been effected in treating mental diseases.

Pinero, Sir Arthur Wing, English dramatist, was born in 1855. His father was a Jewish solicitor of Portuguese extraction. He was educated at private schools, and became an actor in 1874, remaining on the stage until 1881. He commenced his career as a dramatist by writing *£200 a Year* (1877). His earlier plays were for the most part farces, *The Magistrate* (1885), *The Schoolmistress*, and *Dandy Dick*. These farces, while sufficiently amusing, were nevertheless a trifle out of date even when they first appeared; like Falstaff, they were born with a white head. *The Magistrate* had a second avatar as *The Boy*. Pinero's early serious plays were *The Squire* (1881) and *The Profligate* (1889). The former owed its popularity in part to its rural setting, and the latter secured a masterly third act by means of sacrificing probability and abusing coincidence. *Sweet Lavender*, a sentimental comedy, was extremely successful, and has been frequently revived. *The Second Mrs. Tanqueray* (1893) is Pinero's masterpiece, and brought him into the front rank of living dramatists. It was written under the influence of Ibsen, but is a powerful and highly original piece of work. Some of its popularity was due to Mrs. Patrick Campbell, but the main part was due to its intrinsic merits. Among Pinero's later plays are *The Notorious Mrs. Ebbsmith* (1895), *The Gay Lord Quer* (1899), *His House in Order* (1906), and *The Mind the Paint Girl* (1912). Pinero was knighted in 1909. He is a master of dramatic situation, and has a good practical knowledge of the needs and limitations of the stage.—Cf. H. Hamilton Fyfe, *A. W. Pinero*.

Pinero'lo (Fr. *Pignerol*), an ancient city of Italy, province of Turin, at the mouth of the Val Clusone. It has a cathedral, bishop's palace, lyceum, and technical school. The manufactures are chiefly cotton, woollen, and silk goods. It belonged to Savoy from 1042, but the French held it for a series of years on several occasions; and its citadel was the prison of Fouquet and of the Man in the Iron Mask. Pop. 18,000.

Pine Wool, the short, fine fibres of the leaf needles of the pine tree. The preparation of this material is chiefly carried on in Germany

and Sweden. It is used for making wadding, a coarse kind of blanket, stuffing cushions, mattresses, &c., and mixed with other fibres of a longer staple.

Piney Tallow, called also **Malabar Tallow**, is a fatty substance resembling wax, obtained by boiling with water the fruit of the *Vateria Indica*, a tree common on the Malabar coast. It forms excellent candles.

Piney Varnish, a resin used as a varnish, obtained from two trees of Southern India and Ceylon, *Vateria indica* and *V. acuminata*. It is known also as piney resin, white dammar, and Indian copal, and is got by making incisions in the bark of the tree or into its substance. It is soluble in turpentine and drying oils.

Ping-pong, or **Table-tennis**. The game, generally considered, consists in knocking a little celluloid ball over a low net by means of a small racket. *Play*.—Twenty points up is the usual game, one point being lost by the striker for each fault, or for volleying, hitting a ball so that it does not bounce on the table on the opposite side of the net, or failure to knock a ball in play over the net after the first but before the second bounce. No player may serve more than five times successively, and the service changes with each five points scored. Not infrequently ends are changed when 5, 15, 25, and 35 points are called. *Apparatus*.—The regulation size for a ping-pong table is 9 by 5 feet; the net, 6½ inches in height, but lowered by ¾ inch for each foot of shortage in the length of the table. The height of the table should be 2 feet 6 inches. Rackets may be of any type or of any material, but generally they should not exceed 7 by 6 inches in playing surface.

Pinguicula, a genus of plants of the nat. ord. Lentibulariaceæ, with rosettes of fleshy radical leaves, and solitary purple, violet, or yellow flowers. See *Butterwort*.

Pinion, a toothed wheel of small diameter, used in association with a larger gear-wheel or with a rack. Pinions are frequently simple rings of cast iron or steel, with the teeth cut on the outer edge, and with an internal diameter suitable to the shaft. In some cases the pinion and shaft are solid, cut from the same billet. Pinions with helical teeth are used in marine propulsion. (See *Gearing*.) Noiseless pinions built up of layers of paper, cloth, raw hide, and vulcanized fibre have been introduced for machine drives from high-speed electric motors. The comparative lack of strength of such wheels is compensated for by the use of greater widths of wheels and tooth dimensions than those suitable for iron or steel pinions.

Pink (*Dianthus*), a genus of plants belonging to the nat. ord. Caryophyllaceæ. More than 200 species are known, many of which are natives

of the northern and temperate parts of the European continent. Their roots are annual or perennial; the stems herbaceous and jointed; the leaves opposite and entire; and the flowers terminal, aggregate, or solitary, and always beautiful. The clove pink or carnation, and the garden pink, of which there are many varieties, are familiar species.

Pinkerton, John, a Scottish savant, born at Edinburgh in 1758, died in 1826. He was trained for the law, but in 1780 went to London to devote himself to literature, and by his *Letters on Literature* obtained the acquaintance of Horace Walpole. His more valuable publications are: *Ancient Scottish Poems*, from the Manuscript Collection of Sir Richard Maitland of Lethington, with *Notes and a Glossary* (1786); *Inquiry into the History of Scotland preceding the Reign of Malcolm III* (1790); *The Medallic History of England till the Revolution* (1790); *History of Scotland from the Accession of the House of Stuart to that of Mary* (1797); *Iconographia scotica* (1797); a *General Collection of Voyages and Travels* in 17 large volumes (1807-14); *Petralogy* (1811); *A Modern Atlas* (1819).

Pinna, a genus of bivalve molluscs included in the family of wing-shells (*Aviculidæ*). The genus is represented by the *P. pectinata* of the British coasts, by the *P. nobilis* of the Mediterranean Sea, by the *P. bullata*, *P. rudis*, *P. nigrina*, and by other species. Some species attain large dimensions, being as much as 2 feet long. The 'byssus', by which they adhere to rocks, is remarkably long, and of strong silky texture, and is capable of being woven into cloth upon which a very high value is set. This manufacture was known to the ancients, and is still practised in Italy to some extent.

Pinnace, one of the boats of a man-of-war, used to carry the officers to and from the shore. It is usually rowed with eight oars, or is fitted for steam or petrol propulsion. A pinnace is also a small vessel used at sea, having sails and oars, and two or three masts schooner-rigged.

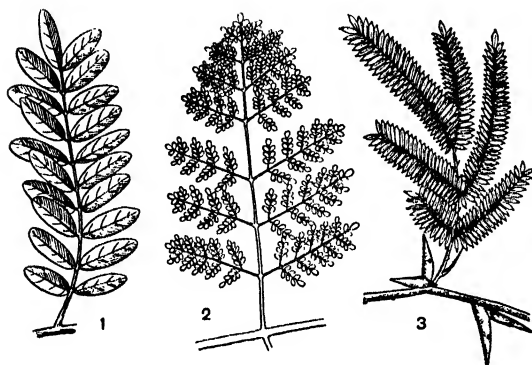
Pinnacle, in architecture, any lesser structure that rises above the roof of a building, or that capes and terminates the higher parts of angles or of buttresses. The application of the term is now generally limited to an ornamental pointed mass rising from angles, buttresses, or parapets, and



Pinnacle—east end of Exeter Cathedral

usually adorned with rich and varied devices. They are usually square in plan, but are sometimes octagonal, and in a few instances hexagonal and pentagonal. The tops are generally crocketed, and have finials on the points.

Pinnate, in botany, formed like a feather. A pinnate leaf is a species of compound leaf wherein a single petiole has several leaflets or pinnae attached to each side of it.



Pinnate Leaves

1, Pinnate. 2, Tripinnate. 3, Bipinnate.

Pinnipedia, a section of the carnivorous order of mammals, in which the fore- and hindlimbs are short, and are expanded into broad webbed swimming paddles. The section comprises the sea-lions, seals, and walruses.

Pinsk, a town of Poland, in the government of Minsk, on the Pina; served by the Brest-Bryansk railway. It stands among marshes, and is built of wood. During the European War Pinsk was occupied by the Germans under Mackensen (Sept., 1915). In 1920, during the Russo-Polish campaign, it was occupied by the Poles, but was subsequently retaken by the Bolshevik troops. Pop. 40,000.

Pint. See *Weights and Measures*.

Pintail Duck, or **Sea Pheasant**, a genus of ducks, so named from the elongated form of the tail-feathers. In size the common pintail duck (*Dafila acuta*) is equal to the mallard. These birds are found on the British coasts in summer, but migrate southwards in winter. They are common in the Mississippi Valley, and they occur on the Mediterranean coasts, in the Gulf of Mexico, in the West Indian Islands, and in Africa. They breed in confinement, and the flesh is savoury.

Pinturicchio (pin - tu - rik'yō; 'the little painter'), Italian painter of the Umbrian school, whose real name was *Bernardino di Betti*, was born at Perugia in 1454, and died at Siena in 1513. He lived for a time at Rome, and while

there was engaged on the frescoes of the Sistine Chapel, being at this time under the influence of Perugino. His chief work was a series of mural paintings illustrating the life of Pope Pius II (*Æneas Silvius*), in the cathedral library at Siena. There are also fine frescoes by him in the Buffalini Chapel of the church St. Maria in Araceli, Rome.

Pinwell, George John, British artist, was born in London in 1842, and died in 1875.

In 1863 he began drawing on wood for the brothers Dalziel and others, and illustrated several works, including *The Vicar of Wakefield*. He was also employed on several periodicals. He began water-colour painting, in which he was very successful, in 1865, his pictures including two subjects from Browning's *Pied Piper of Hamelin* (1869), *The Elixir of Love* (1870), *Away from Town* (1871), *Gilbert à Becket's Troth* (1872), *The Great Lady* (1873), and *We fell out, my Wife and I* (1875). He was elected an Associate of the Society of Painters in Water-colours in 1869, and full member in 1870.

Pinzon, a family of Spanish navigators, natives of Palos, who were associated with Columbus in the discovery of America.

—Martin Alfonso, the eldest, was of great assistance to Columbus in fitting out his fleet, and in the voyage commanded the *Pinta*.—Vicente Yañez, his brother, commanded the *Niña* in the first voyage of Columbus.—Francisco Martin, the third brother, was pilot of the *Pinta* in the first voyage of Columbus. From him descended the noble Spanish family of Pinzon.

Piombino, formerly an independent principality of Italy, now part of the province of Pisa. From 1233 to 1309 it belonged to Pisa, and was afterwards ruled by independent princes until 1801, when it was incorporated with France. A principality under Elise Bacciochi, a sister of Napoleon, from 1805 to 1814, it was united with the Duchy of Tuscany in 1815.

Piombino, a town of Italy, province of Pisa, on the sea-coast opposite the Island of Elba. It has old fortifications, a good harbour, and manufactures of Bessemer steel and military projectiles. Pop. 8000.

Piombo, Sebastiano Luciani del, Italian painter, born at Venice in 1485, died in 1547. He studied under Giovanni Bellini and Giorgione, whose fine colouring he imitated. Coming to Rome about 1512, he was induced by Michelangelo to enter into rivalry with Raphael. When Raphael painted his celebrated *Transfiguration*, Sebastiano attempted to surpass it by painting *The Raising of Lazarus*, which is considered his greatest work, and is now in the National Gallery, London. Other important

works are *The Scourging of Our Lord* and *A Holy Family*. His chief merit, however, lay in single figures and portraits, such as his *Clement VII*.

Pioneers and Pioneer Battalions. Pioneers are military artificers, and pioneer battalions are units which are trained for the purpose of performing the ordinary duties of infantry, and, at the same time, the more elementary of those which would normally come into the province of the Royal Engineers. In a battalion of infantry the pioneer-sergeant and his assistants include men trained in the trades of carpenter, blacksmith, and so on, and in the exercise of these trades they are very useful members of the battalion. In former days pioneers, in order to distinguish them from the other rank and file of the unit, were permitted to wear beards, and on a march moved at the head of the battalion, carrying the tools of their trade, to enable them to clear away any obstructions that might be met with on the road.

Pioneer battalions are in the British service of very modern date, having only come into existence during the European War. Then, among the New Army units raised in districts where the available personnel consisted largely of miners, a considerable number of pioneer battalions were formed, with the idea of using them on service in such a way that their peculiar technical knowledge should be used to the best advantage. These were the pioneer battalions which gave such a good account of themselves in the war, either as fighters or as miners. Now that the New Army and its service battalions have ceased to exist, there are no longer any pioneer battalions in the British service. Though, as we have seen, pioneer battalions do not form parts of the regular British army, yet in India they have existed as units of the infantry of the Indian army for many years. In that army some ten or twelve infantry regiments are known as pioneers, and the name has a definite significance, for these regiments are trained in peace-time and made available in war-time for the execution of many kinds of military works, such as road- and railway-making, or for purely infantry work as required. Their work can, in fact, be considered complementary to that of the Indian sappers and miners officered by Royal Engineer officers. British officers of Indian pioneers are, on the contrary, infantry officers who undergo a special course of instruction in pioneer work.

Plotrków, a town of Poland, capital of the district of the same name. It is on the River Strada, and is served by the Warsaw-Vienna Railway. It was at one time the seat of the Polish Diet, and the kings were elected there. Pop. 40,000.—The district has an area of 4729 sq. miles. It is one of the industrial areas of

Poland, Lodz, an important textile centre, being the largest town. Pop. 2,000,000. See *Poland*.

Piozzi, Hester Lynch Salusbury, British authoress, the daughter of John Salusbury of Bodvel, Carnarvonshire, born in 1741, died at Clifton 1821. In 1763 she was married to Henry Thrale, a wealthy brewer of Southwark, London, which borough he then represented in Parliament. Soon after her marriage she gathered round her a brilliant circle, including above all Dr. Johnson, who lived with the Thrales several days in each week for sixteen years. Mr. Thrale dying in 1781, his widow, who was the mother of four daughters, married in 1784 Piozzi, a Florentine music-master, then resident in Bath. This alliance was keenly resented by all her friends, and Johnson entirely gave up her society. She wrote a few poems and an autobiography, but she is chiefly known by her *Anecdotes of the late Samuel Johnson*, during the last Twenty Years of his Life (1786), and *Letters to and from the late Samuel Johnson*, LL.D. (1788).

Pipa, a genus of toads, of which the best-known species is the *Pipa americana* of Surinam and Brazil, popularly designated the Surinam toad. The tongue and teeth are wanting in this



Pipa Toad (*Pipa americana*)

family. The pipa is one of the most repulsive looking of the toads, and is noted as exemplifying, in the case of the female animals, an anomalous mode of developing the eggs and young. A number of pits or depressions termed 'dorsal cells' appear to be formed on the back of the female pipas at the breeding season. In each cell an egg is deposited, the eggs being first deposited by the female in water after the usual method, and being impregnated by the male, who then collects the eggs and places them in the female's back. Each cell appears to be closed by a lid-like fold, and within the cells the eggs are hatched and the young pass their tadpole state.

Pipe, a tube, usually circular in cross-section,

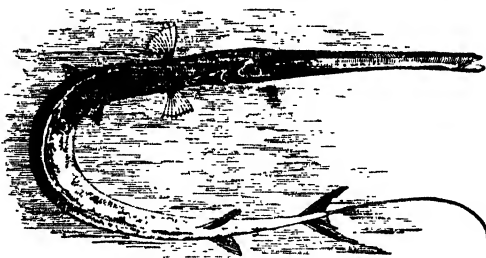
which is used for the distribution of such fluids as water, steam, coal-gas, and compressed air. The material of which the pipe is made is determined after consideration of the properties of the substance to be conveyed and its condition of pressure and temperature. Cast-iron steam-pipes are still used for low pressures, but they are heavy, liable to fracture if struck, and very rigid at bends. Cast iron is never used for pipes which are to convey superheated steam, because of the peculiar breakdown of structure which takes place in cast iron when it is subjected to high temperatures. Important steam-pipes are usually made of mild steel, solid drawn or welded, and with the flanges screwed on or welded. Steam-pipes are subjected to considerable temperature changes, and they expand and contract by amounts which must be allowed for in designing a pipe range. To permit this expansion to take place, expansion joints or bends are introduced into the system. The joints are made with pieces of copper pipe provided with flanges, or with pipes one of which is inside the other and thus free to expand. Bends, if of large radius, may introduce sufficient flexibility into a pipe range to permit all the possible expansion to take place. Steam-pipes are supported on rollers to permit the pipes to expand towards the bends and expansion joints. At all joints in a steam-pipe system rings of packing material are used to ensure steam tightness. If expansion can take place freely, these joints will remain intact. Steam leaks at the joints will be early seen in a system where the expansion has not been completely allowed for. Steam-pipes are subject to water-hammer, due to the acceleration of water which remains in pockets or low parts of the pipe range, and is set in motion by the condensation of entrapped steam.

Wrought-iron welded tubes have come into very extensive use for the distribution of gas. Solid-drawn weldless tubes are used for boiler-tubes, hydraulic pipes, and such purposes as shafting and boring-rods. Cast-iron pipes used for water-mains are usually cast vertically to ensure soundness of the metal throughout its structure. Remelted cast iron is used for hydraulic power-mains, the pipes of which are tested under considerable pressures before being put into actual use. If the pressure in use is 700 to 900 lb. per square inch, a test pressure of 2500 lb. per square inch is used, and this value is increased for higher service pressures.

Pipe, Tobacco, a bowl and connecting tube, made of baked clay, wood, stone, or other material, and used in smoking tobacco. The cheap clay pipes, which were once in universal use in Great Britain and are still much used, are made of a fine-grained white, plastic clay, found chiefly in the Isle of Purbeck in Dorset-

shire, and at Newton Abbot in Devonshire. The chief processes in the manufacture of clay pipes are moulding and baking. Finer and more expensive pipes are made of meerschaum, a somewhat plastic magnesian stone of a soft, greasy feel. Sometimes the bowl alone (which is frequently artistically carved) is of meerschaum, the stem being of wood, the best sorts of which are got from the young stems of the Mahaleb cherry, grown near Vienna, the mock orange of Hungary, and the jessamine sticks of Turkey. The stem, whether of the same material as the bowl or of wood, is usually provided with a mouthpiece of ivory, silver, or amber, the last being preferred. Briar-root pipes, with the bowl and stem of one piece of wood, and provided with amber, ivory, or bone mouthpieces, are made of the roots of a large variety of heath (Fr. *bruyère*). The Persian *hookah* is a pipe of great size, the bowl of which is set upon an airtight vessel partially filled with water, and has a small tube which passes down into the water; the long flexible smoking-tube is inserted in the side of the vessel, and the smoke is made to pass through the water, being thus cooled and deprived of some noxious properties. Upon the American continent pipes have been in use from a very remote period. Indian pipes, with elaborately carved soapstone bowls and ornamented wooden stems, or entirely of baked clay, have been found in the ancient mounds of the West, together with other relics of an unknown race. See *Calumet*.

Pipe-fishes (*Syngnathus*), fishes nearly allied to the curious little forms popularly known as



Pipe-fish (*Fistularia tabaccaria*)

'sea-horses' (see *Hippocampus*), and included with them in the same family (*Syngnathidae*). They are distinguished by a long and tapering body, and by jaws united to form a tube or pipe, bearing the mouth at the tip. The *Syngnathus acus* is the most familiar British species. It averages 20 inches in length. The largest of the British species is said to attain a length of 3 feet. A very remarkable circumstance in connection with the pipe-fishes consists in the males of some species possessing a pouch-like

fold, situated at the base of the tail, in which the eggs are contained after being extruded from the body of the females, and in which the young, after hatching, continue to reside for a time. The name pipe-fish is also applied to the members of the genus *Fistularia*, belonging to a different family (*Fistulariidae*), and also known as flute-mouths. The bones of the face are prolonged to form a tubular structure, at the extremity of which the mouth opens. The *Fistularia tabaccaria* of the Antilles, averaging about 3 feet in length, represents this genus.

Pipera'ceæ, the peppers, a natural order of shrubby or herbaceous apetalous dicotyledons, inhabiting the hottest parts of the globe, particularly India and South America. The general properties of the order are aromatic, pungent, and stimulant. The dried unripe fruits of *Piper nigrum* constitute black pepper (see *Pepper*). The fruit of *Piper (Cubeba) officinâlis*, a climbing plant of Java and other Indian islands, is the Cubeb pepper (see *Cubeb*). The leaves and unripe fruit of *P. angustifolium* constitute the aromatic, fragrant, and astringent substance called *matico* or *matica*, which has been recommended for checking hæmorrhage. The leaves of *P. Belle (Chavica Bette)* are chewed in the East as a means of intoxication (see *Betel*). The root of *Macropiper methysticum* is the *kava* of the South Sea Islanders, and is used in the preparation of a stimulating beverage.

Pipe Roll, a term applied to the Annual or Great Rolls of the English Exchequer, preserved in the Record Office, London. They are so called on account of their being rolled into the shape of pipes, or because they were sent to the Crown Office in cylinders. The Rolls relate to all matters connected with the revenues of the Crown, and extend from the reign of Henry II (1156) to 1833. In 1883 a society (The Pipe Roll Society) was formed with the intention of publishing all the Pipe Rolls.

Piping-crow, a bird of New South Wales, remarkable for its power of mimicking the voices of other birds. It is the *Gymnorhina tibicen* and related species. It belongs to the shrike family.

Pipistrelle (*Vesperugo pipistrellus*), the familiar little bat which occurs throughout Britain, and flits about during twilight. It is of small size, and possesses a mouse-like body covered with hair, from which resemblance its popular name of Flitter-mouse has been derived. It passes the winter, like most other bats, in a state of torpidity; but appears to hibernate for a shorter period than other and larger species.

Pipit, or **Titlark** (*Anthus*), a genus of perching birds possessing striking affinities with the larks, which they resemble in the large size of the hinder claw, but commonly classed with the wagtails (*Motacillidæ*), which they closely re-

semble in their habit of running swiftly on the ground. The meadow pipit or titlark (*Anthus pratensis*) is the commonest British species. The shore pipit or rock lark (*A. obscurus*) frequents the sea-beach, and feeds on molluscs and crustacea. The tree pipit (*A. trivialis*) is a summer visitant only in the British Isles. All the pipits build their nests on the ground. The song in all consists of a clear, simple note, that of the tree pipit being imitated by the words *pit-pit*.

Pippin, the name given to a certain class of dessert apples, probably because the trees were raised from the pips or seeds, and bore the apples which gave them celebrity without grafting. They seem to have been introduced into Great Britain from France, and were little known there until about the end of the sixteenth century. The Ribston, Golden, Cox's Orange, and Newton Pippin are favourite varieties.

Pipra, a genus of perching birds which inhabit South America. See *Manakin*.

Pipsissewa, also known as *chimaphila* and *prince's pine*, a North American evergreen plant (*Chimaphila umbellata*) of the heath order (*Ericaceæ*). From its leaves are made a powder and a fluid extract, used in America in kidney complaints, scrofula, rheumatism, &c.

Piqua, a city of Ohio, United States, in Miami county, on the Miami River; served by the Cincinnati, Hamilton, & Layton, and the Pittsburgh, Cincinnati, Chicago, & St. Louis Railways, and by the Miami & Erie Canal. There are some manufactures. Piqua, originally a settlement of a division of the Shawnee Indians, was founded in 1809 as Washington, the present name being adopted in 1823, and the town became a city in 1846. Pop. 15,000.

Piquet, a game at cards played between two persons with thirty-two cards, all the plain cards below seven being thrown aside. In playing, the cards rank in order as follows: the ace (which counts eleven), the king, queen, and knave (each of which counts ten), and the plain cards (each of which counts according to the number of its pips). The player who first reaches 100 has the game. The score is made up by reckoning in the following manner: *carte blanche*, the point, the sequence, the quatorze, the cards, and the capot. *Carte blanche* is a hand of twelve plain cards, and counts ten for the player who holds it. The point is the suit of highest value, the value being determined by the number it makes up when the cards held are added together. The sequence is composed of a regular succession of cards in one suit. The quatorze is composed of four aces, four kings, four queens, four knaves, or four tens, and counts fourteen. The winner of the greatest number of tricks counts

ten in addition (the 'cards'); if he holds all the tricks, he counts forty in addition (the 'capot'). If a player scores twenty-nine in hand and one for the card he leads, before his opponent counts anything, he at once adds thirty to his score; this is called 'pique'. Should a player score thirty by the cards in his hand, by scores that reckon in order before his adversary can count, he obtains the 'repique', which enables him to add sixty to his score. The scores are recorded according to the following table of precedence: (1) *carte blanche*, (2) point, (3) sequences, (4) quatorzes and trios, (5) points made in play, and (6) the cards. If one player scores a hundred before the other obtains fifty, he wins a double.

Piracy, the crime of robbery and depredation committed upon the high seas. It is an offence against the universal law of society, a pirate being, according to Sir Edward Coke, *hostis humani generis*. In England the offence was formerly cognizable only by the Admiralty courts, which proceeded without a jury, in a method founded upon the civil law; but now any justices of assize, or oyer and terminer, or jail delivery, may try persons accused of piracy. Piracy, in the common sense of the word, is distinguished from privateering by the circumstance that the pirate sails without any commission, and under no national flag, and attacks the subjects of all nations alike: the privateer acts under a commission from a belligerent power, which authorizes him to attack, plunder, and destroy the vessels which he may encounter belonging to the hostile state.

Piræus (Gr. *Peiraieus*), one of the chief seaports of ancient Greece. It was situated about 5 miles from Athens, with which it was connected by the two 'Long Walls', and the whole Peninsula of Peiraieus was surrounded by a wall 60 stadia in circumference, about 60 feet (40 cubits) in height, and probably 14 or 15 feet thick. The Peiraieus was fortified by the architect Hippodamus of Miletus to the order of Themistocles, and the town proper was laid out for Pericles by the same architect. The modern Piræus has three harbours: two on the east side, anciently named Zea (now Stratiotiki) and Munychia (now Phanari), and one (the largest) on the west side, called simply Piræus, or the Harbour. When Greece was liberated from Turkish rule, the Piræus was merely a scene of ruins. Pop. 74,000. See *Athens* (latter portion of article).

Piranha, or **Cariba** (Serrasalmo), a voracious freshwater fish of tropical America. It is 3 or 4 feet in length, and its jaws are armed with sharp lancet-shaped teeth, from which cattle when fording rivers sometimes suffer terribly.

Pirates. Pirates have existed as such from the earliest times, and although the act of

piracy is now universally regarded as a ghastly crime against all mankind, yet there have been many occasions upon which the depredations of a pirate have not only been helpful to his nation as a body, but have also been officially encouraged and more or less legalized. Naval warfare is a vastly different proposition to warfare by land, and naval tactics, as exemplified in the 'head', 'prize', 'blood-money', and prize courts of the twentieth century, may be summed up as involving the seizure of as much enemy property as possible, and the subsequent distribution of the booty by a gradation according to rank. This was the policy of the ancient Greeks, of the Romans and Carthaginians, of the Vikings, of the Moors after the disruption of the Caliphate of Cordoba, of the privateers fitted out privately during the reign of 'good Queen Bess', and furnished with letters of marque authorizing them to prey upon the shipping of that most obnoxious enemy of England, Philip of Spain; and within the last few years the same policy directed German activity at sea when she turned loose upon the international maritime highways such ships as the *Morue* and *Emden* and her commerce-destroying submarines. Commerce-destroyers, however, are not technically considered as 'pirates', although Lord Nelson once ventured the opinion that they were "little better". Piracy, then, until within comparatively recent times, was synonymous with and was the direct accompaniment of naval warfare, in which every stranger was a prospective enemy, and every enemy meant more plunder. This was ultimately reflected more in the spending and drinking capacity of the individual seaman than in the pride and glory of conquest, and honour and prestige in the profession of arms.

In remote ages pirates were of a quite different type to their more modern descendants, for not only did they raid and plunder by land—a proceeding which may be accounted for by the smallness of the ships of the time, their small carrying capacity offering little or no booty—but they also infested whole countries, suppressed nationalities, and even established permanent colonies. An instance of this is afforded by one of the primitive peoples of Ireland—the *Tuatha de Danaan*, who came probably from Mediterranean lands and settled in that country. In the preface to M'Firbis's *Book of Genealogies* we read:

"... Every one who is fair-haired, vengeful, large, and every plunderer . . . who are adepts in all Druidical and magical arts,—they are the descendants of the Tuatha de Danaan in Erin."

The Tuatha de Danaan, then, were a tall, fair race, with a propensity alike for magic and piracy.

When Haco of Norway sailed to the invasion of Scotland (Alexander III) in 1263, he had with him one Roderic, a pirate chief, who claimed Bute as his inheritance, but who had been opposed by the islanders and outlawed by Alexander. Haco was little better than a pirate himself, and while his fleet of 160 galleys was anchored in Kilbrannan Sound, between the mainland of Scotland and the Island of Arran, he dispatched 60 ships up Loch Long under the command of Magnus, King of Man (modern Isle of Man), four Hebridean chiefs, and two Norse captains. This fleet ravaged and pillaged to the head of the loch, and drew its galleys across the narrow isthmus of Arrochar-Tarbet which separates Loch Long from Loch Lomond. The Scots of Lennox and Loch Lomondside in general had found a safehold in the islands of the inland loch, little anticipating the stratagem which the inherent boldness of the Norsemen and the lightness of their craft enabled them to conceive, and they were all put to the sword and their houses and goods burnt and plundered by the conquerors, who even penetrated to the wealthy inland town of Stirling, looting and burning the adjacent countryside on their way. On their return they dragged their boats back from Tarbet to Arrochar and set sail; but a terrific storm arose, and ten galleys were completely wrecked. The remaining vessels did not rejoin Haco in the Firth of Clyde until three days after the Scottish victory at Largs.

Piracy at this time was obviously an organized division of legitimate warfare. The post-Elizabethan buccaneer, engaged in offensive operations for his own benefit, was non-existent, and cannot be said to have become common among Englishmen until the time of Hawkins and Francis Drake. The early career of Francis Drake provides an index to the misfortunes and bitterness that accompanied the transition period from honest seamanship to piracy, its more glamorous counterpart. Drake was early apprenticed to the sea, and eventually became owner-master of his own vessel. He invested his savings in a trading expedition to San Juan de Ulloa, but was treacherously attacked by a Spanish admiral, his companions being murdered and his ships burnt and pillaged, and Drake returned to England, ruined and dispirited, nursing in his heart an unquenchable thirst for vengeance against Spain, and considering from that time that all Spanish merchantmen were a fair prey. For four years he worked to re-establish himself, and eventually, keeping his own counsel, he commissioned at Plymouth a sloop (the *Dragon*) and two small pinnaces, in which he set sail in the autumn of 1572. At this time Spanish gold was brought across Panamá by

pack-mule train from the Peruvian mines, and was reshipped at the mouth of the Chagres River. Drake was always silent regarding his exploit at Panamá, and the customary wild rumours advertised his success in glowing terms, making many others wish to share in his exploits and, incidentally, to get rich quickly and easily. Briefly, Drake surprised the mule-train and possessed himself of an enormous plunder in precious metals and stones. He sailed down the Atlantic coast of South America into the Pacific, capturing and plundering everything Spanish by sea, and within a reasonable distance by land, rounded the Cape of Good Hope, touched at Sierra Leone, and swept triumphantly into Plymouth Harbour, having circumnavigated the globe. Drake and his kinsman Hawkins were undoubtedly corsairs of the same stuff as Odysseus or the Vikings, but their patriotic efforts to support their queen and their nation have raised them to a place in history which, although they may be sneered at privately as pirates, is publicly sanctioned by their feats as empire-builders.

The pirate of the romantic novel has never existed outside the imagination of the novelist, but in Bartholomew Roberts some critics have identified the Cleveland of Sir Walter Scott's *Pirate*. While this may be so, it is an undoubted fact that the names of Cleveland's associates are identical with those of Roberts's henchmen. Bartholomew Roberts was a native of Pembrokeshire, where he was born in 1682. He was mate of a vessel captured and plundered by Howell Davis at Anamaboe, in the Guineas, and was retained by that worthy, who was killed six weeks later in a fray at Prince's Island, Roberts becoming captain in his place. Roberts was the last of the great pirates, and was said to be comparatively a humane person. The following are extracts from Pyle's version of the articles drawn up by Bartholomew Roberts and subscribed to on oath by his satellites:

1. Every man has a vote in affairs of moment, and is entitled to equal provision in the matter of provisions and strong liquors. . . .
2. Every man to be called fairly in turn by list on board of prizes . . . and to be allowed a shift of clothes . . . over and above his proper share. Marooning the punishment for defrauding the ship's company in any way or for deserting ship or quarters in battle. Desertion might also be punishable with death.
3. No dice or gaming with cards for money.
4. All lights to be doused by eight in the evening, and drinking after that hour to be on the open deck. (Roberts was only a moderate drinker, and is supposed to have framed this article in an ineffectual attempt to suppress orgies of drinking.)
5. Piece, pistols, and cutlass to be kept clean and fit. (Pistols were slung by a cord over the shoulders, and arms generally were scrupulously cleaned and delighted in.)
6. No boy or woman allowed on board. (To carry one of the opposite sex to sea in disguise was punishable with death.)
7. Differences of opinion to be discussed with arms and ashore, not on board ship.

8. £1000 per man to have been shared before a disruption is proposed. Men losing limbs to receive 800 dollars from the 'pool', lesser wounds being remunerated in proportion. (The captain and quartermaster each received two shares in a prize, the master, boatswain, and gunner receiving one share and a half respectively. Other officers were paid one share and a quarter.)

It remains to be noted that archipelagos and deeply indented coast-lines are peculiarly suitable as lurking-places for pirates. This accounts for regular gangs frequenting definite zones, their marauding expeditions outside of their specific 'preserves' partaking of the same nature as naval raids on definite objectives, too frequently dictated and carried on under the pressure of a dire necessity. Such places as the Norwegian fiords, the Ægean Archipelago, the Indian Ocean, the West Indies, Nancowry, and the Sicilian and Dalmatian coasts were therefore eminently suitable, and were much used by pirate gangs. Modern navies, the paid servants of the states to which they belong, have now an iron-handed control of the recognized international maritime highways, and their abolition or partial disablement as a preventive force would herald the return of the pirate, just as the disbandment of police forces or gendarmerie by land would expose all honest people to the rapacity of marauding freebooters and would even threaten the perversion of the law-abiding citizen. See *Drake; Hawkins; Kidd; Nancowry; Privateer; Roberts; Bartholomew; Rogers; Vikings*.—BIBLIOGRAPHY: Howard Pyle (editor), *The Buccaneers and Marooners of America*; J. A. Froude, *English Seamen in the Sixteenth Century*.

Pirna, a town of Saxony, on the Elbe. It originated in a Slavonic settlement which became united with Meissen, and passed to Saxony about 1405. Dominating the town is the Sonnenstein, erected by Augustus I, Elector of Saxony, and once the most important fortress on the Elbe. Glass and pottery are manufactured in the town. Pop. about 22,000.

Piron (pê-rôn), Alexis, French wit, poet, and dramatist, born at Dijon in 1689, died in 1773. He studied law at Besançon; but having gone to Paris, he wrote for the Theatre of the Opéra-Comique, and his first piece, *Arléquin Deucalion*, was composed in two days. In 1738 he produced his *chef-d'œuvre*, *Métromanie*, a comedy excelling in plot, style, humour, and vivacity almost every other composition of the kind. His attempts to gain admission to the Académie Française failed. Piron revenged himself by calling the Academy *Les invalides du bel esprit*, and by composing the humorous epitaph:

Ci-gît Piron, qui ne fut rien,
Pas même Académicien.

Pirot, a town of Serbia, Yugo-Slavia, on the Nishava; served by the Nish-Sofia-Constan-

tinople trunk line. It is the capital of the department of Pirot. Carpets and cloth are manufactured. Pirot was occupied and held by Bulgar troops during the Serbo-Bulgarian War of 1885, and was again taken by the Bulgarian armies on 26th Oct., 1915. A Serbo-French detachment re-entered the town on 14th Oct., 1918. Pop. 11,000.—The department has an area of 900 sq. miles, and a pop. of about 114,000.

Pisa, a maritime province of Tuscany, North Italy, on the Ligurian Sea, drained in the north by the Arno. Marble, copper, and coal are among the minerals produced. Oil, wine, and cereals are also produced, and cottons, soap, and glass are among the manufactures. Area, 1180 sq. miles; pop. 360,787.

Pisa (ancient *Pisæ*), a city of Tuscany, North Italy, capital of the province of Pisa, on the Arno, 6 miles from the Ligurian Sea, connected by rail with Florence, &c. Pisa is of immense historical interest in view of her former hegemony in art and letters, and it was the foundation of the cathedral of Pisa that ushered in the splendour and glory of Italian mediæval art. This cathedral, constructed entirely of white marble, was consecrated by Pope Gelasius II in 1118, and was restored between 1597 and 1604; the baptistery, also in white marble, was begun by Diotisalvi in 1153, but was not completed until about 1278. A world-famous Pisan sight is the Campanile, or 'leaning tower', a clock-tower begun by the architects Bonnanus of Pisa and William of Innsbruck in 1174. It was completed by Tommaso Pisano in 1350, and is eight stories (179 feet) high. The cause of its remarkable oblique position (16½ feet off the perpendicular) is not known. Within the tower are six bells, one 6 tons in weight. The Campo Santo (burial-ground) is peculiarly sacred. It was founded between 1188 and 1200 by Archbishop Ubaldo, who sanctified the ground by depositing thereon fifty-three shiploads of earth from Calvary. One of the Pisan institutions that has lost little of its former importance is the university, a twelfth-century foundation, accommodated in a building of 1493, extended by Cosimo I in 1542-3. Galilei was professor of mathematics at Pisa in 1589. There is a university library of about a quarter of a million volumes.

The leading manufacture is of cottons. Near by there are a royal stud-farm (horses and dromedaries) and mineral-springs.

History.—All authors agree in representing *Pisæ* as a very ancient city, but accounts of its early history are confused and unreliable. There is reason to believe, however, that it was one of the early Pelasgic settlements on the coasts of Etruria, which subsequently fell under the domination of the Etruscans. There are no

extant remains of the Etruscan occupation, and practically nothing is known of the city as an Etruscan possession. In 180 B.C. it became a Roman colony, and was named by Augustus *Colonia Julia Pisana*. About the beginning of the Christian era it was a flourishing city. On the fall of the Roman Empire it was pillaged by the Goths, and afterwards subjected by the Longobards. In the tenth century it had succeeded in taking a lead among the Italian states; but, after protracted and unsuccessful wars with Genoa at the end of the thirteenth, and with Florence at the end of the fifteenth century, it was finally compelled by famine to submit to the Florentines (8th June, 1509), and thus ceased for ever to be independent. On the ruins of Pisa was founded the power of the Grand-Duchy of Tuscany.

Pisa, Council of, a general Council of the Roman Catholic Church, held to consider the pretensions of the rival Popes of Avignon and of Rome, opened 25th March, 1409. The rival Popes, Benedict XIII (of Avignon) and Gregory XII (of Rome), were summoned to appear within a stated period, but refused to comply. After mature deliberation both Popes were formally deposed, and Cardinal Pietro Philargi, Archbishop of Milan, was elected Pope (Alexander V). The authority of the Council was not, however, generally recognized, and it was not until 1417 that the schism can be said to have terminated. There were two other Councils at Pisa, one in 1183, and another in 1511.

Pisagua, a seaport of the province of Tarapacá, Chile; served by railway from Iquique. It is a great transport centre for nitrate of soda. On 19th Nov., 1879, the allied (Peruvian and Bolivian) armies were defeated by the Chilians at Pisagua. Pop. about 5000.

Pisces (the Fishes), the twelfth and last of the signs of the zodiac, which the sun enters about 19th Feb. The constellation of the name does not now correspond with the sign, but contains the vernal point, or First Point of Aries. See *Precession of the Equinoxes*.

Pisciculture. The art of pisciculture has been practised from very early times. It is known that in 1000 B.C. the Chinese reared fish both for ornament and for the table by procuring fish eggs and caring for them in specially constructed ponds. The Greeks and Romans stocked ponds (vivaria) and lakes, by throwing in spawn. With the spread of Christianity and periodic abstention from meat, fish culture spread all over Europe; every large establishment and monastery had its fish-ponds, stocked with carp, eels, &c.

Modern Methods.—At the present time the term pisciculture is used for various operations, including (a) the artificial fecundation of ova and care of the larvæ, for the purpose of re-

stocking depleted waters, or for the introduction of species into countries to which they are not indigenous; (b) the acclimatization of fish by use of such larvæ or of adults; (c) fish-farming and allied activities.

(a) The first recorded experiments in artificial fertilization were carried out by Ludwig Jacobi in Westphalia in 1747. He mingled the milt of the male with ova from the female trout, and raised the fry to the age of six months. Karl Lund in Sweden soon followed him, and by 1845 experimental fertilization and study of the fry had been extended to salmon and various other fishes. Ripe or mature fish are selected from fish penned in enclosures; the signs of ripeness are readily evident to the expert. The female is induced to extrude the ova into trays by gentle pressure, the male is similarly treated, and fertilization is thus effected. In the 'dry' method no water is added until milt and ova have been mingled together by gentle stirring. The 'dry' has superseded the 'wet' method, in which water was added before the milt, as it has been found that in the old method a certain proportion of ova remained sterile. Subsequent treatment depends on the character of the eggs.

(1) *Heavy non-adhesive eggs* (trout, salmon) are washed and placed on perforated tin trays (zinc has been found to be injurious). The eggs require much oxygen, which is supplied by a continuous stream of pure water. When the eggs hatch, the larvæ live for some time by the absorption of food from the yolk sac, which lies beneath the body. If intended for transportation, the fry are usually sent at this stage; in other cases they are kept in rearing-ponds until over a year old, the trays used being kept in constant motion. When the sac has been absorbed, the fry are fed at frequent intervals on finely ground fish or liver, or a commercial food prepared for the purpose. After attaining a certain size they can be turned into the rearing-ponds and fed on liver and the larvæ of insects.

(2) *Heavy adhesive eggs* (herring, smelt, perch) have been dealt with on an experimental scale.

(3) *Semi-buoyant eggs*. White fish (*Coregonus albus*) is hatched on a commercial scale in the United States.

(4) *Buoyant eggs* (cod, plaice, soles, turbot, &c.) are kept in continuous motion. The fry are fed on plankton (q.v.).

Fresh-water Hatcheries.—The most extensive are in the United States and in Canada. France and Germany have State-aided hatcheries, and Great Britain has many commercial hatcheries.

Marine Hatcheries.—Millions of cod and plaice eggs are hatched annually for the Norwegian Government. The larvæ are liberated when able to search for their own food. The Fishery Board

for Scotland has since 1894 been concerned in hatching sea fish (cod, &c.), first at Dunbar, afterwards at Nigg. A considerable number of plaice and other flat fish are hatched at Port Erin, the hatchery being supported by the Manx Government, and at Piel.

(b) *Acclimatization*.—By the transportation of fry across the continent the shad has been placed on the Pacific seaboard of the United States. The introduction of adult fish into a country has been particularly successful in the case of German carp in America, this fish being set out in waters unsuitable for salmon. Trout and salmon have been introduced into New Zealand and Australia.

(c) *Fish-farming, El Farms*.—Elvers coming up from the sea are caught in tidal waters by means of partially open boxes filled with weed. Great numbers are taken in this way by the Ministry of Agriculture and Fisheries at Epney, on the Severn, and are traded within the kingdom, and also exported. In Denmark elvers are taken in the same way, and are fed with unmarketable fish in lagoons close to the coast.

Plaice.—Plaice are transplanted from the open sea to the protected waters of the Lim Fjord in Denmark, and from the crowded coastal grounds to the Dogger Bank.

BIBLIOGRAPHY: Bulletins of the Bureau of Fisheries, Washington, United States; contributions to Canadian Biology, Ottawa; Annual Reports of the Fishery Board for Scotland, the Lancashire and Western Sea Fisheries Committee, and the Danish Marine Biological Station; International North Sea Fishery Investigations, Southern Area, 1904-9.

Piscidia, a genus of plants, nat. ord. Leguminosae, the species being West Indian trees. The bark of the root of *P. Erythrina* (dogwood tree) is a powerful narcotic, and is used as a substitute for opium, and also for poisoning fish. The timber makes excellent piles for docks and wharves, being heavy, resinous, and almost imperishable.

Piscina, in ecclesiastical usage, a small basin supplied with water, set in a niche or recess on the south side of the altar in churches. It is used to hold the water in which the priest washes his hands, and for rinsing the chalice.

Pisé (pē'sā), material for forming the walls of cottages, agricultural buildings, &c., consisting of stiff clayey materials usually mixed with gravel well rammed into a frame, and when dry forming a good strong wall. These walls are thicker at bottom than at top. They must not be built too rapidly.

Pishin, a district of British India, in Baluchistan; traversed by the Quetta-Kandahar Railway. It consists of a plain surrounded on three sides by hills rising to the height of about 11,000 feet, while the general height of the plain is

5000 feet. The people live mostly by pasturage or agriculture. It was occupied by the British in 1878, and assigned to them (from Afghanistan) by the Treaty of Gandamak in 1879. Area, 2700 sq. miles; pop. about 60,000.

Pisidia, in ancient geography, a province of Asia Minor, situated between Phrygia, Cilicia, Pamphylia, Lycia, and Caria. The inhabitants were warlike mountaineers, and were never really subdued by the Romans.

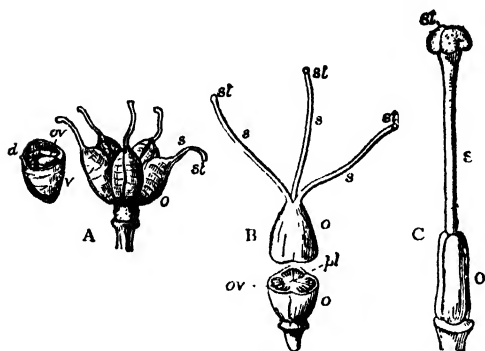
Pisistratus (Gr. *Peisistratos*), 'tyrant' of Athens, descended from Codrus, the last King of Athens, was born not later than 612 B.C., and died in 527 B.C. He was rich, handsome, and eloquent, and, being by nature ambitious, he soon placed himself at the head of one of the three parties into which Attica was then divided. By putting himself forward as the patron and benefactor of the poor, and by advocating civil equality and a democratic constitution, he was able (notwithstanding the opposition of Solon) to seize upon the acropolis (citadel) in 560 B.C., and thus to make himself master, or, as the Greeks termed it, 'tyrant' of the city. But though a tyrant in the Greek sense, his use of power was by no means tyrannical. He made no attempt to abolish the wise laws of Solon, but confirmed and extended their authority. He was, however, twice driven from Athens; but in the eleventh year of his second banishment succeeded in making himself master of the sovereignty for the third time. Pisistratus erected splendid public buildings at Athens, established a public library, and collected and arranged the poems of Homer, and conducted himself with so much prudence and clemency that his country scarcely ever enjoyed a longer term of peace and prosperity. He left two sons, Hippias and Hipparchus, to inherit his power, who were not, however, able to preserve it.

Pisolate, a rock composed of globules about the size of a pea, usually formed round a minute grain of sand or other foreign body, and joined with a cement. The material is commonly calcite or aragonite, but iron ores are often pisolitic. See *Oolite*.

Pistachio (pis-tā'shi-o), a tree of several species, of the genus *Pistacia*, nat. ord. Anacardiaceae, growing to the height of 15 to 20 feet. *P. vera* yields the well-known pistachio-nut, which contains a kernel of a pleasant taste, resembling that of the almond, wholesome and nutritive, yielding a pleasant oil. It is a native of Western Asia, but is much cultivated in the south of Europe. The gum named mastic is obtained from *P. lentiscus*, as well as from *P. atlantica*. See *Mastic*.

Pistil, in botany, the female or central seed-bearing organ of a phanerogamous flower, consisting of one or more *carpels* or modified leaves.

There may be only a single pistil or several in the same flower. It consists essentially of two parts, the *ovary*, containing the ovules or young seeds, and the *stigma*, a cellular secreting body, which is either seated immediately on the ovary (as in the tulip and poppy), and is then called *sessile*, or is borne on a stalk called a *style* interposed between the ovary and stigma. It is on the stigma that the pollen falls, this pollination



Forms of Pistil

A, Apocarpous. B, C, Syncarpous o, Ovary;
s, styles; st, stigma; pl, placenta; ov, ovules;
d, dorsal and v, ventral sutures.

being followed by *fertilization*, as a result of which the ovule develops into the seed. See *Botany; Flower; Placenta*.

Pistoja (pis-tō'yā; ancient *Pistoriae*), a walled city of Tuscany, North Italy, in the province of Florence, on the Ombrone. The Romanesque cathedral of S. Jacopo dates from the twelfth to thirteenth century, and the thirteenth-century campanile, originally a fortified tower called the Torre del Podestà, bears the arms of governors of the town. There are manufactures of iron and steel goods, fire-arms, and linen. Pistols were first made here, and received their name from the town. Pistoja is mentioned in ancient history as the scene of the defeat and death of Catiline in 62 B.C., and it was the focus of the mediæval struggles of the Guelphs and Ghibellines. In the history of art Pistoja ranks in importance between Florence and Pisa. Pop. 65,000.

Pistol, a fire-arm designed to be used and fired by one hand only, though some of the modern varieties of automatic pistols can be fitted to a temporary stock (formed of the wooden holster or pistol-case) and fired from the shoulder, thus giving a greater degree of steadiness. The name is generally accepted (cf. Grose, *Military Antiquities*, 1786) to have been derived from the town of Pistoja, in Tuscany, where the original weapon of this class was invented in the fifteenth century. This

early pistol was known as a 'dag', and was fired by means of a 'match' held by a curved arm of iron, which, being pivoted in the middle, was brought down on to the priming by pressure on the lower end as on a trigger. Although this appears to have been the earliest method of ignition, it was very quickly superseded by the 'wheel-lock', combined with the flint-and-steel method of ignition. This wheel-lock, according to an ancient manuscript quoted by Grose (vol. i), consisted of a small wheel attached to the right side of the pistol, and connecting inside the weapon with a spring operating the hammer. The wheel, on being rotated by means of a key, compressed the spring, and at the same time uncovered the priming-powder in the pan; all that then remained to be done was to press the trigger, when the hammer holding a flint fell on the steel of the priming-pan, and the resulting spark ignited the powder. As the knowledge of the science of gun-making increased, improvements were made in pistols, which, in a general way, followed much on the same lines of development as the musket, though the actual method of ignition by means of flint and steel remained in favour for very many years. The wheel-lock mechanism, however, was discarded in favour of a simpler contrivance of springs contained entirely in the inside of the pistol. As fire-arms began to be adopted—possibly somewhat diffidently—by soldiers, so the pistol, as being not entirely unsuitable for use on horseback, became the arm of cavalry, the German Reiters (mercenary troops) being credited with its use as early as 1544. In any case, it was in full use as a cavalry weapon in the seventeenth century, and Grose gives a selection of woodcuts depicting the use of the weapon by a mounted dragoon in the



Pistol, early Eighteenth Century

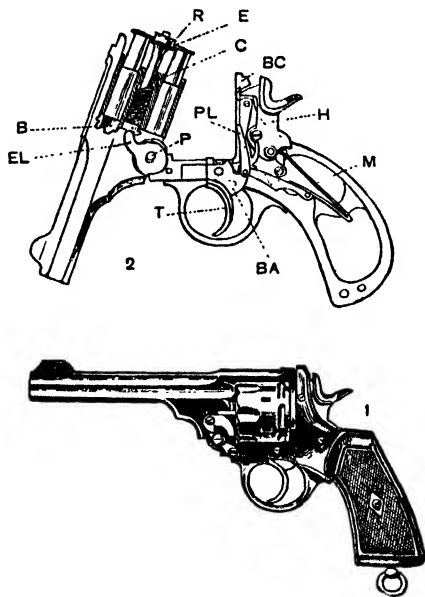
first half of the century. The weapon then in use was a clumsy flint-lock contrivance, with a barrel 1 foot long and a probable over all length of some 20 inches. This weapon was carried in a holster on the off side of the pommel of the saddle, and all operations necessary for loading and firing were carried out when mounted. A rather later variety of the pistol, marked 'Tower', was fitted on the left side with a spring clip, by means of which it could be carried on the belt or sash. To such an extent was the pistol

relied on that, on the Continent at least, it became the chief arm of the greater part of the cavalry, to the entire exclusion of the *arme blanche*.

It is, however, in connection with the practice of duelling that the pistol is best known, and was brought to a high degree of accuracy by the skilled gun-makers of the eighteenth cen-

sonal protection on a journey, there being at that time no civil police, although there was no lack of desperadoes throughout the country. Consequently gun-makers, in addition to perfecting the duelling pistol—a heavy but well-balanced and elaborately got up weapon with a hair trigger—produced other varieties for more everyday use, i.e. horse-pistols, meant to be carried in holsters attached to the saddle; sash or belt pistols, to be worn on a waist-belt; and pocket pistols of a smaller and lighter make, to be carried in the large pockets of the coat of the period. In due course the percussion principle—invented by Forsyth early in the nineteenth century—was adopted by most makers of pistols, and gave a considerable fillip to their development.

For very many years—in fact from soon after pistols were first invented—attempts had been made to contrive a weapon which would lessen one of the chief disadvantages under which the single-barrel pistol necessarily laboured. This disadvantage, which was more obvious in the pistol than in the musket—the pistol being essentially an arm of opportunity and only used at close quarters—consisted in the absolute impossibility of reloading in a hurry; thus, should the first and important shot prove a failure, the pistol was useless except as a missile weapon. Attempts to remedy this state of affairs, by the invention of a repeating pistol, were many and various, ranging from the fixed barrel, with a cylinder revolved by hand, of the sixteenth-century match-lock pistols, through the multi-barrelled pistols or 'pepper-pots' of flint-lock and percussion days, down to the fixed barrel and mechanically revolving cylinder of the modern revolver. Blanch, in his *Century of Guns*, gives, among others, a representation of a flint-lock revolver made by Collier in 1818, with one barrel and a revolving cylinder, and another of an earlier type of pepper-pot, so arranged that at the first discharge two barrels were fired, still leaving four more for eventualities. But in course of time, and as normal conditions of life became rather more settled, the development of the pistol into the modern revolver was transferred to the less settled parts of the world, and it probably received more attention in America, and more especially in the Western States. There, in 1835, Colonel Colt patented his fixed-barrel revolver provided with a cylinder, which was loaded as a muzzle-loader from the front of the cylinder, each compartment of which had a nipple requiring to be capped; the action of cocking the hammer revolved the cylinder. Although this was the first of the modern revolvers, Adams of London improved on this, and invented a revolver having what is known as a double-action, by which is



1, Webley's "Revolver Pistol" (Mark VI). 2, Explanatory diagram, the weapon being shown open. When the trigger (T) is pulled, the pawl (PL) acting on the ratchet (R) at the after end of the cylinder (C) revolves the cylinder till the next cartridge is brought into line with the barrel (B). The back end of the trigger-arm (BA) at the same time forces the hammer (H) backwards. Continued backward motion of the trigger causes its back end to slip off the foot of the hammer, allowing the mainspring (M) to drive the latter forward until its nose strikes the cap and explodes the cartridge. To reload, pressure is put on the barrel-catch (BC), which releases the barrel pivoted on the pin (P), allowing it to drop down, and the spent cartridges are thrown out by the extractor (E), knocked upwards by the extractor lever (EL) as the barrel falls.

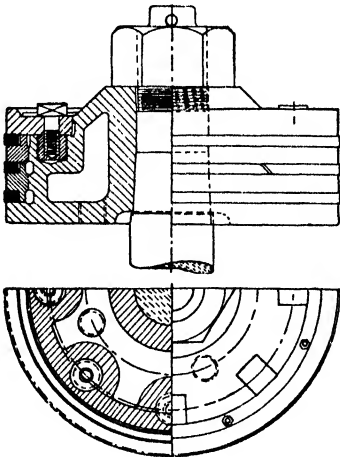
tury: in fact, the eighteenth and early nineteenth centuries may be considered the age in which the pistol—in its muzzle-loading form—had its greatest vogue. Duelling, the direct descendant of the ancient trial by battle, became in its later years (the last duel in England took place in the 'forties of last century) an undoubted scandal; but the fact remains that it was a custom, and the gun-makers were quick to take advantage of it and improve the make of pistols in accordance with the extent of knowledge then possessed by them. Pistols were also required by travellers for their per-

meant that the revolution of the cylinder is effected either by pulling the trigger or cocking the hammer. This method, which is practically universal in modern revolvers, makes, of course, for rapidity of fire. A still more modern development of the arm is the automatic pistol, in which the force of the recoil is made use of in much the same manner as in machine-guns.

The revolver in use in the British service at the present time is the 'Webley', of which the length of the barrel is 4 inches and length over all $10\frac{1}{2}$ inches, with a calibre of $\cdot 441$ inches. The cylinder holds six cartridges, and the weight of the pistol is 2 lb. 3 oz. This is the service pattern, though others with longer barrels are made for the more accurate purposes of match-shooting. Among other revolvers and automatic pistols are the Smith & Wesson revolver, and the Webley, Colt, and Browning automatic pistols, besides many of German manufacture.

Pistole (pis-tôl'), the French name for the Spanish gold unit, a double *escudo* worth 16s. $11\frac{1}{4}$ d. English. It was in use from 1537, and is now obsolete. Coins of similar value, such as the *Louis d'or*, also received this name.

Piston, in engineering, a movable flat or dished plate or cylinder which is used for the purpose of transmitting the pressures of some medium, such as water, steam, or gases, to the mechanism of an engine. The term is also used for the same device when used to transmit the pressure component of available power to a medium the pressure on which is to be raised.

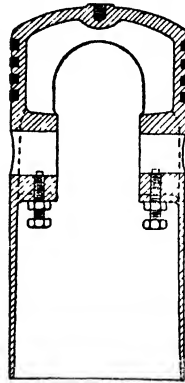


Steam-engine Piston

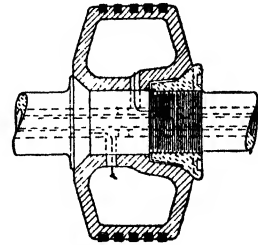
The piston has a reciprocating motion, under the action of the varying pressure upon it. The form it takes is varied to suit the individual requirements of each case. In an engine

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the piston must be free to move to and fro with little frictional resistance, but at the same time must be so constructed as to prevent leakage taking place between it and the cylinder or liner. Piston-rings are introduced into grooves cut in the cylindrical face of the piston of a steam- or gas-engine piston to prevent this leakage. These piston-rings are commonly made of cast iron and of a diameter slightly greater than that of the engine cylinder. A portion of



Gas-engine Piston



Water-cooled Piston as used in Double-acting Gas-engines

each ring is cut out. The ring can then be inserted in its groove in the piston, and the gap in the ring closed up by compression to allow the piston to be passed into the cylinder. The ring always presses against the cylinder-wall, in consequence of the forces which tend to restore it to its original form. Two or three rings are used on each piston, with their ring-gaps arranged at such intervals as to make the possibility of leakage very small. Rings, in some designs, are pressed outwards by small steel springs inserted in recesses in the piston. The variety of patent piston-ring arrangements is almost limitless. Gas-engine pistons usually have quite distinctive forms. In a single-acting gas-engine the piston is made in the form of a long cylindrical cup, in which fits the gudgeon-pin, which is used to connect the piston to the connecting-rod. In engines of this type working on the two-stroke cycle, a shaped projection on the top of the piston acts as a gas-deflector (see *Motor-car Engines*). More rings are used on a gas-engine piston than on a steam-engine piston, because the pressures in use are greater. The piston of a double-acting gas-engine is usually made hollow, and provided with cooling water. Where pistons are to be used with hydraulic plant, packing materials, such as leather, tallowed rope, and many trade preparations, are used instead of rings.

Pitcairn Island, an island in the South

Pacific, 100 miles south of the Tuamotu (Low Archipelago); length, $2\frac{1}{2}$ miles; breadth, about 1 mile. It was discovered by Carteret in 1767, and named after the midshipman who first sighted it. Since 1839 it has been a British possession. Its coast is almost perpendicular throughout its whole extent, fringed with formidable rocks and reefs, accessible only at two points, and not at all in stormy weather.

Pitcairn Island is chiefly remarkable as the home of the descendants of the *Bounty* mutineers, nine of whom, together with six men and twelve women, natives of Tahiti, landed here in 1790. Violent dissensions soon arose, and at the end of ten years the only survivors were John Adams, an Englishman (whose real name was said to have been Alexander Smith), the females, and nineteen children. They were found in 1808 by the American, Captain Folger, who reported the discovery to the British Government. The interest thus aroused soon brought other visitors to the island, all of whom dilated with enthusiasm on the virtuous, sober, and industrious life led by the inhabitants. They became, however, too numerous to subsist comfortably on this small island, and they were transferred, to the number of 194, to Norfolk Island in 1856, but about 40 soon returned. In 1881 the inhabitants numbered 96; in 1901, 126; and in 1914, 140 (35 being adult males, 39 adult females, and 66 children). By religion they are Seventh Day Adventists. Taro, sugar-cane, yams, sweet potatoes, melons, oranges, pumpkins, bananas, pineapples, and arrowroot are products, with some coffee.

Pitch. There are three principal kinds of pitch, namely, coal-pitch, wood-pitch, and the naturally occurring mineral-pitch, usually called asphalt.

Coal-pitch is obtained from coal-tar, being the residue left in the still when the distillation of coal-tar is completed (see *Coal-tar*). According as the distillation is interrupted earlier or later, soft or hard pitch is produced. One ton of coal-tar produces on the average 54 tons of pitch. It consists chiefly of a mixture of hydrocarbons.

Pitch is a black, lustrous substance which breaks with a conchoidal fracture. Although it can be broken and is hard and apparently solid, it is in reality a very viscous fluid, for it will flow extremely slowly under the influence of its own weight. Soft pitch begins to melt at about 40°C ., and hard pitch at about 100°C . If pitch is distilled, heavy oils are collected, and coke remains in the still as the final product. It is used for making briquettes, asphalt, asphalt paper, roofing felt, for tarring the surfaces of roads, and for the preparation of black varnishes and lacquer.

Briquettes contain from 5 to 10 per cent of

pitch as a binding material for coal-dust. In making asphalt, pitch is used in conjunction with natural pitch, and is mixed with about three times its weight of stony material, such as sand and gravel, before being laid down. Varnishes are made from pitch by mixing it with creosote oil or coal-tar naphtha. Such varnishes are very effective in protecting wood-, iron-, or stone-work from corrosion and rendering materials waterproof.

Natural asphalt or mineral-pitch is found in Trinidad and Syria (see *Asphalt*). Wood-pitch is the product left behind in the still after the distillation of wood-tar (see *Wood-tar*). It is a dark, resinous substance, and is used for caulking ships, and for making waterproof cements, cobbler's wax, &c.

Pitch, in music, may be defined as the position of any particular note in the great ascending scale of sounds extending from the lowest or 'gravest' to the highest or most 'acute'. It may be exactly indicated by giving the number of double vibrations per second which will produce it. The higher this number is the higher in pitch is the resulting sound. The lack of a universally accepted standard of pitch in the past has been the source of much inconvenience in connection with musical performances, but at the close of the nineteenth century the French *diapason normal* was generally adopted. This gives A on the second space of the treble stave as = 439 double vibrations per second, and is generally referred to in this country as the 'new' philharmonic pitch. The corresponding number for C on the third space of the treble stave is $\frac{2}{3} \times 439 = 527$; for C an octave lower (i.e. the middle C of the piano) the number is $\frac{1}{2} \times 439 = 263$ (see *Acoustics*). Unfortunately our military bands are still (1922) at the old, higher pitch. For theoretical purposes the number for the middle C of the piano is often taken to be 256. This is thought to correspond closely to the 'classical' pitch, used, e.g., by Bach, Handel, and Beethoven.

Pitchblende, a mineral chiefly found in Saxony and Cornwall in association with lead, copper, or tin ores, and composed of uranium oxides with some lead. Its special interest in modern times lies in the fact that it is radioactive, and that both radium and helium can be separated from it. In colour it varies from brown to black, and occurs globular, reniform, massive, disseminated, and pulverulent. Specific gravity as high as 9.7.

Pitcher-plant, a name given to several carnivorous plants from their pitcher-shaped leaves, the best known of which is the *Nepenthes distillatoria*, a native of China and the East Indies, and belonging to the nat. ord. Nepenthaceae. It is a herbaceous perennial, and grows in marshy

situations. The leaves are sessile, oblong, and terminated at the extremities by a cylindrical hollow vessel resembling a common water-pitcher, which contains a digestive fluid secreted by the plant itself. This pitcher, which acts as a trap for insects, is furnished with a lid that is regarded as the true blade of the leaf. Won-



Pitcher-plant (*Nepenthes ampullaria*)

derful curative powers are ascribed to the fluid in the pitcher and to the leaf and the root of this plant by the natives of the East Indies and Madagascar. See *Carnivorous Plants*.

Pitchstone, a volcanic glassy rock with a pitchy look, not so highly vitreous as obsidian. It occurs commonly as dykes, where rapid cooling of a lava with a high percentage of silica has taken place. *Tachylyte* is, however, a pitchstone of basaltic composition.

Pitch'urim-beans, the name given to the lobes of the drupe of *Nectandra puchury*, a South American species of laurel, used by chocolate-makers as a substitute for vanilla.

Pith, the cylindrical or angular column of parenchyma at or near the centre of the stem of a plant, also called the *medulla*. It is not usually continued into the root, but is always directly connected with the terminal bud of the stem, and also by means of the medullary rays with the cortex. The pith is at first succulent and of a greenish colour, afterwards it becomes dry, and in many plants its cells are broken up, leaving large cavities. It serves chiefly for storage.

Pithecanthropus Erectus, the name given by E. Dubois (afterwards professor of geology in the University of Amsterdam) to a very primitive extinct member of the human family, the fossilized remains of which were found by him in 1891 and 1892 near Trinil, on the bank of the Solo River in Central Java. The parts recovered were a skull-cap, two teeth, and a thigh bone in a bed that contained the fossilized remains of many extinct mammals, the Indian analogies of which led Dubois to believe that in *Pithecanthropus* he had discovered a so-called 'missing link' of Pliocene age; but subsequent investigations, and especially those carried out by the Selenka Expedition, have discredited the belief in the Pliocene date assigned to the beds, and have strengthened the evidence in favour of referring them to the Early Pleistocene age. The discovery of these fossils aroused widespread controversy when Dubois' account of them was first published in 1894; and the disputes which then began have not yet been settled. Apart from the question of age, to which reference has already been made, there are two other categories of controversial issues. In the first place, many competent biologists refuse to admit that the skull-cap, teeth, and femur are parts of one individual or even of the same genus of living creatures; but Dubois replies to this criticism by the statement that all the fragments were found in the same geological horizon and probably represent parts of one individual, whose straight thigh is regarded as evidence for the invention of the specific name *erectus* given by Dubois to *Pithecanthropus*. Then there is the further problem as to the rank of *Pithecanthropus*. Dubois claimed that it was a 'missing link' intermediate between men and apes. Many German and some French authorities contend that the skull-cap is that of a gigantic ape akin to the gibbon. But the anatomical characters of the brain (as revealed by the mould of the inside of the skull) make it quite certain that neither of these pretended explanations is justifiable. *Pithecanthropus* is certainly a member of the human family, and far and away the earliest and most primitive human genus of which we have any exact knowledge concerning the form of the head. A fossil tooth found in America early in 1922 suggests the former existence of an even more primitive member of the human family, who lived in what is now Nebraska in Pliocene times; but until we know something of the form of the head of this creature, which Professor Osborn has named *Hesperopithecus*, we cannot be certain of its right to be included within our family, although the resemblance of its tooth to that of *Pithecanthropus* suggests a close kinship to the latter.

Pitlochry, a village and tourist centre of Perthshire, Scotland, on the Tummel, and served by the Highland Railway. There is a large hydropathic establishment. Tweed is woven and whisky distilled. Near by are the Pass of Killiecrankie, Loch Tummel, and the Falls of Tummel. Pop. 3000.

Pitman, Sir Isaac, the inventor of a system of shorthand, was born at Trowbridge, Wiltshire, in 1813, and died in 1897. In 1832 he became a schoolmaster, and published his *Stenographic Sound-Hand* in 1837. From this time he devoted himself to perfecting his shorthand system and to spelling reform. His *Phonetic Journal* was founded at Bath in 1842, and was the beginning of the publishing house of Isaac Pitman & Sons. Sir Isaac was knighted in 1894.—Cf. A. Baker, *Life of Sir Isaac Pitman*.

Pitt, William, British statesman, younger son of the Earl of Chatham, born at Hayes, Kent, 28th May, 1759, died 23rd Jan., 1806. He possessed a remarkably precocious intellect, but as his physical powers were weak, he was educated privately till his fourteenth year, when he entered Pembroke College, Cambridge. He was called to the Bar in 1780, and entered Parliament the following year as member for Appleby. His success in the House was of unparalleled rapidity. He supported Burke's financial reform Bill, and spoke in favour of parliamentary reform; became Chancellor of the Exchequer at twenty-three, under the Earl of Shelburne, and in the following year attained the position of Prime Minister. Although strongly supported by the sovereign, he stood opposed to a large majority of the House of Commons, and a dissolution took place in March, 1786. At the general election which followed, the voice of the nation appeared decidedly in his favour, and some of the strongest aristocratical interests in the country were defeated, Pitt himself being returned by the University of Cambridge. His first measure was the passing of his India Bill, establishing the board of control, which was followed by much of that fiscal and financial regulation that gave so much *éclat* to the early period of his administration. The establishment of the delusive scheme of a sinking fund followed in 1786, and his Regency Bill in 1788. The French Revolution now broke out, and in 1793 war arose between Great Britain and France, a conflict which brought a heavy responsibility on Pitt, and immense sacrifices and burdens on his country. In 1800 the Irish union was accomplished. In 1801 the opposition to the Irish Catholics caused Pitt to resign his post. The new minister, who had renewed the war, unable to maintain his ground, resigned; and in 1804 Pitt resumed his post at the Treasury. Return-

ing to power, he exerted all the energy of his character to render the contest successful, and found means to engage the two great military powers of Russia and Austria in a new coalition, which was dissolved by the battle of Austerlitz. This event he did not survive long; his constitution, weakened by hereditary gout, rapidly yielded to the joint attack of disease and anxiety. Parliament decreed a public funeral to his honour, and a grant of £40,000 to pay his debts. Pitt was more a man of expedients than of principles. A warm advocate of parliamentary reform in the outset of his career, he soon abandoned the cause. He spoke and voted in favour of the abolition of the slave-trade, but did not make a ministerial measure of it. As a financier he was an expert in practice rather than scientifically grounded, while the waste of his war-time expenditure was extreme. Neither can it be said that any decided social amelioration was due to his influence. His ruling passion was love of power, but he was above the meanness of avarice, and his personal disinterestedness was extreme. As an orator he was, on the whole, more impressive than his father or even Burke, the indignant severity and keenness of his sarcasm being unequalled.—BIBLIOGRAPHY: Lord Rosebery, *William Pitt* (Twelve English Statesmen Series); Charles Whibley, *Political Portraits*; D. O. Madden, *The Age of Pitt and Fox*; J. H. Rose, *Life of Pitt*.

Pit'tacus, one of the seven wise men of Greece, born about 652 B.C., died 569 at Mitylene, on the Island of Lesbos. He was highly celebrated as a warrior, a statesman, a philosopher, and a poet. In 589 the citizens raised him to the dictatorship, an office which he filled for ten years, when he voluntarily resigned it.

Pittenweem, a royal and municipal burgh and seaport town of Fifeshire, Scotland, on the Firth of Forth; served by the North British Railway. There is a fishing and curing industry. Pittenweem became a royal burgh in 1542. Pop. (1921), 1774.

Pittsburgh, a city and port of entry of Pennsylvania, United States, the county seat of Allegheny county, on the Ohio formed at this point by the combination of the Allegheny and Monongahela Rivers; served by the Baltimore and Ohio lines of the Pennsylvania, the Pittsburgh, & Lake Erie, the Buffalo, Rochester, & Pittsburgh, and half a dozen other railways. It is admirably situated for trade, having ample river and railway connection with the great commercial emporiums of the east, west, and south, while in the immediate neighbourhood there are immense coal deposits. These exceptional advantages have made Pittsburgh the chief centre of the American iron and steel industry. The glass manufactures

of Pittsburgh also rank first in importance in the United States; cotton goods, leather, earthenware, white lead, soda, tobacco, and spirits are largely produced; but the chief exports are iron and steel, hardware and machinery, glass, coal, and coke. Pittsburgh consists of the town proper and of several large suburbs, and with those that are on the opposite side of the rivers the connection is kept up by many bridges. Of the adjacent places, some, though separately incorporated, are really suburbs of Pittsburgh; the most important, Allegheny, on the right bank of the Allegheny River, a favourite residence with the wealthier classes, was united with Pittsburgh in 1908. The city possesses many fine public buildings and institutions. Among these are Pittsburgh University with many departments, and the Carnegie Institute, including library, art, musical, and technical departments, and museum. There are several large parks. Natural gas is much used.

Pittsburgh occupies the site of a fort called Du Quesne, built by the French in 1754, captured by the British in 1758, and named after William Pitt, Earl of Chatham. It was chartered in 1816.

Pittsfield, a city of Massachusetts, United States, the county seat of Berkshire county, on the Housatonic; served by the New York, New Haven, & Hartford, and the Boston & Albany Railways. It has manufactures of cotton and woollen goods, silk, castings, machinery, tools, paper, boots and shoes, and malt products. Pittsfield was settled in 1743 and 1749, and became a city in 1891. Pop. (1921), 41,751.

Pittston, a city of Pennsylvania, United States, in Luzerne county, on the Susquehanna River; served by the Erie, the Lehigh Valley, the Central of New Jersey, the Delaware, Lackawanna, & Western, and the Lackawanna & Wyoming Valley Railways, and by electric railways to Scranton, Plymouth, &c. It lies in the chief anthracite coal area of the United States. Pittston was settled in 1770, and became a city in 1894. The name commemorates William Pitt (Earl of Chatham). Pop. about 19,000.

Pituitary Body, or **Pituitary Gland**, a small body situated towards the base of the brain. The name, derived from the Lat. *pituita*, phlegm, was given to it because it was supposed to discharge phlegm or mucus down the nostrils.

Pityriasis is a chronic skin affection characterized by scaling of small portions of the skin. The disease is very common, and may affect the scalp and later the body. In the scalp it is known as pityriasis capitis or dandruff, and shows easily detached scales, leading to atrophy of the hair. It appears in childhood between the ages of six and ten, and many members of the same family may be affected.

It may persist for years, and if untreated lead to a gradual loss of hair, leaving a smooth, shining baldness (alopecia).

In the body the condition is known as pityriasis circinata, and affects at first chiefly the upper part of the chest in front and behind. Later the eruption spreads to other parts. It begins as a small spot, pink in colour, and covered with a greasy scale. This spreads and forms a ring, and when the disease is well established the ring-like grouping is typical.

Treatment of the scalp is essential, as it is the origin of the trouble, and this is done by suitable lotions, used as a shampoo, or by antiseptic ointment. Pityriasis of the body is best treated with sulphur ointment. If the condition were satisfactorily treated in childhood, there would be few eruptions among adults.

Piura, the northernmost maritime department of Peru, partly belonging to the torrid coastal plain, and partly within the broken mountainous region of the Western Cordillera. Petroleum, sulphur, and salt are produced; the making of Panamá hats is a universal cottage industry; sheep, cattle, goats, and mules are raised in the hinterland, and some rough cotton and tobacco are produced in the uplands of the interior and in the valleys of the Chira, Piura, and Tumbes, which traverse the coastal plain. The two former valleys are irrigated and densely peopled. Piura is the capital, and is connected by railway with Paita, on the coast (Paita-Piura Railway, 61 miles). It was founded by Pizarro, in 1531, as San Miguel, and was then located at Tangarara, somewhat nearer Paita. Area, 16,825 sq. miles; pop. (approximately), 200,000.

Pius II (Æneas Sylvius Piccolomini), Pope, born at Corsignano 1405, died at Ancona 1464. He was descended from an illustrious Tuscan family, and studied at the University of Siena. He became secretary to Cardinal Capranica, and the Council of Basel in 1431; to the Antipope Felix V in 1439, and to Frederick III of Germany in 1442. The emperor sent him as Imperial Ambassador to a Diet at Ratibon, and in 1446 to Pope Eugenius IV to negotiate the submission of Germany. He gained the favour of Eugenius, whom he had formerly opposed, and by his successor was created Bishop of Trieste in 1447, and cardinal in 1456. He succeeded Calixtus III as pontiff in 1458. In 1460 he published a Bull condemning the doctrine he had in former years so vigorously defended: the superiority of a general council to the Pope. He roused Christendom against the Turks, and planned a crusade against Islam, but died before he had time to carry it into effect. Pius II was one of the most learned men of his age, and the literary fame of Æneas Sylvius has somewhat eclipsed his his-

torical importance as Pope.—Cf. C. M. Ady, *Pius II, the Humanist Pope*.

Pius V (Michele Ghislieri), Pope, born in 1504, died 1572. He was raised to the cardinalate by Paul IV in 1557, appointed inquisitor in Lombardy, then inquisitor-general, and chosen Pope in 1565. Pius V chiefly distinguished himself by his cruel persecutions of Protestants and Jews; the Bull *In Cœna Domini* was renewed by him, and the authority of the *Index Expurgatorius* enforced. In 1570 he excommunicated Elizabeth of England. He lent his influence and assistance to Charles IX of France against his Protestant subjects, and to the Venetians and Spaniards in their war against the Turks. He was canonized by Clement XI in 1712, and his festival is held on 11th May.

Pius VI (Giovanni Angelo Braschi), Pope, born at Cesena 1717, died at Valence 1799. He held important offices under several pontiffs, was raised to the cardinalate by Clement XIV, and succeeded him in 1775. Several beneficent reforms were introduced by him in the finance department; he also improved the Vatican museum, drained the Pontine Marshes, reconstructed the port of Ancona, and embellished Rome. The French Revolution, however, hastened the decay of the temporal power of the holy see. In 1791 Avignon and the county of Venaissin were reunited to France, and by the Treaty of Tolentino (1797) he lost the Romagna, Bologna, and Ferrara. In 1798 General Berthier established the Roman Republic, and the Pope, having refused to renounce his temporal sovereignty, was carried off a prisoner to France, where he died.

Pius VII (Gregorio Barnaba Chiaramonti), Pope, born at Cesena in 1742, died 1823. A Benedictine monk for several years, he became Bishop of Imola and cardinal in 1785. His friendly attitude towards the Cisalpine Republic secured him the favour of France, and the election to the Papal chair in 1800. He concluded a concordat with Napoleon in 1801, but aroused the open enmity of the emperor by refusing to recognize his brother Joseph as King of Naples. The results were the incorporation of the Papal cities, and shortly after of Rome itself, with the Kingdom of Italy, and the arrest of the Pope (6th July, 1809) and his confinement in Savona and afterwards at Fontainebleau. He was released in 1814, and restored to the possession of all the Papal territories except Avignon and Venaissin in France, and a narrow strip of land beyond the Po. His subsequent government was politically and ecclesiastically of a reactionary character.

Pius IX (Giovanni Maria Mastai-Ferretti), Pope, born 13th May, 1792, died 7th Feb., 1878. Ordained in 1819, he was appointed Archbishop

of Spoleto in 1827, and raised to the cardinalate in 1840. Elected Pope in 1846, on the death of Gregory XVI, his accession was signalized by the release of 2000 political prisoners, followed by a complete amnesty. Inspired by the dream of a free Italy, Pius IX was anxious to realize the ideal of a federated Italy under the supremacy of the Popes. Having declared himself against war with Austria, he was compelled in consequence of a series of riots to flee. A Roman Republic was proclaimed (Feb., 1849), with Mazzini at its head. Restored by French troops, he returned in 1850. In 1870 the dogma of Papal infallibility was established by the Ecumenical Council. By this time the Pope's dominions had been greatly reduced, and what remained of the temporal power was secured by the presence of French troops at Rome. But the downfall of Napoleon III caused their withdrawal; the Italian troops took possession, and the political rule of the holy see was at an end.—Cf. Raffaele de Cesare, *Last Days of Papal Rome, 1850–1870*.

Pius X (Giuseppe Sarto), Bishop of Rome and Supreme Pontiff of the Roman Catholic Church, was born of humble parents at Riete, in the province of Tréviso, Italy, in 1835, and died in 1914. He was ordained in 1858, and was appointed canon of the cathedral and superior of the seminary at Tréviso in 1875. In 1880 he refused the bishopric of Tréviso, but four years later he was compelled by Leo XIII to accept that of Mantua, and became (12th June, 1893) Cardinal and Patriarch of Venice. He succeeded Leo XIII on 4th Aug., 1903, and occupied the Papal chair for eleven years, during which he enforced a vigorous policy of reform and reconstruction within the Church. On the outbreak of the European War he refused to comply with the Austrian emperor's request for his blessing, saying, "I bless peace, not war", and there can be no doubt that the European War materially hastened his end.

Pius XI (Achille Ratti), Bishop of Rome and Supreme Pontiff of the Roman Catholic Church, was born on 31st March, 1857, at Desio, near Milan, where his parents were engaged in the manufacture of silk, and was ordained in 1879. In 1900 he visited England to carry out research work in the Bodleian Library at Oxford, and also visited Manchester as the guest of his friend the Bishop of Salford. Pius X appointed him prefect of the Ambrosian Library in 1906, and ten years later he was also called to the prefecture of the Vatican Library, where he speedily became distinguished for his great learning and piety and for his affability of manner, all of which qualities endeared him to those cardinals with whom he came fre-

quently in contact. He is a keen student of history and philology, and is said to have an almost perfect knowledge of twenty-seven languages, ancient and modern. Benedict XV appointed him Apostolic Nuncio, and entrusted him with a mission of great delicacy in Poland (1918), on the successful accomplishment of which Benedict speedily demonstrated his appreciation by nominating him simultaneously to the Roman Purple and to the archbishopric of Milan (13th June, 1921), recently vacated by the death of Cardinal Ferrari. On 6th June, 1919, he had been made an archbishop of the Curia, with the titular see of Lepanto, and in April, 1921, he became titular Archbishop of Adana.

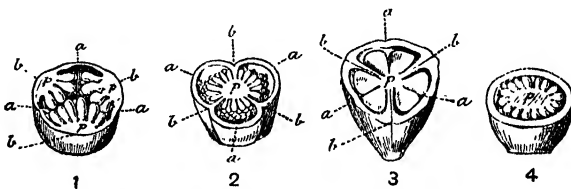
On the death of Benedict XV, Cardinal Ratti became Pope as Pius XI, and his appointment was acclaimed by the multitude. His election was due primarily to his non-party beliefs, for he never identified himself with either school of thought in the Church on the question of the relationship between the Vatican and the temporal power in Italy. As evidence of the change in the Vatican policy, the traditional ceremony of blessing the people, usually performed from within the Basilica, was carried out openly from the Vatican terrace, where the Papal flag appeared for the first time since the days of Pius IX (q.v.).

Pizarro, Francisco, Spanish adventurer and conqueror of Peru, was born at Trujillo in 1478, the illegitimate son of an hidalgo, Gonzalo Pizarro, and was first a swineherd and then a soldier. The spirit of adventure which at that time pervaded Spain prompted him to seek fortune in the newly found continent of America, where he participated in various military and trading expeditions. While resident near Panamá he became associated with two other adventurers, Hernando Luege, or de Lueges, and Diego de Almagro. In 1524 they jointly fitted out an expedition with a view to exploration and conquest, and on their second voyage discovered Peru, but finding their force inadequate for conquering the country, Pizarro returned to Spain for assistance. He arrived in Seville in 1528, was granted the necessary powers and a small force, and recrossed the Atlantic in 1531. The following year he arrived in Peru during a civil war, treacherously seized the person of the reigning Inca at a friendly banquet, and, after extorting an immense ransom, put him to death. The whole empire was gradually conquered without much opposition, but its settlement was long in abeyance owing to a feud between Pizarro and Almagro. Hernando Pizarro, a brother of the general,

strangled Almagro in 1537. This act was avenged in 1541 when a son of Almagro murdered Francisco Pizarro in his palace at Lima. Lima was founded by Pizarro in 1535, and his remains are interred in the cathedral of that city, also founded by him.—Cf. F. A. Ober, *Pizarro and the Conquest of Peru*.

Placen'ta, the structure attached to the lining of the womb, which provides the means whereby the foetus, or unborn embryo, obtains from the mother's blood the nutriment needed for its growth. In its most typical form it is met with in the higher Mammalia, which used to be called *placental* mammals, under the belief that lower Mammalia, the two orders Monotremata and Marsupialia, did not develop a placenta; but in 1895 J. P. Hill showed that in some of the marsupials (more especially *Perameles*) a true placenta was found. Certain analogous structures also exist in connection with the development of the young of some species of sharks and dog-fishes. By the end of pregnancy the human placenta forms a disc-like mass, measuring $7\frac{1}{2}$ inches across, $\frac{3}{4}$ inch thick, and about 20 ounces in weight. Connected with it near the middle is the umbilical cord, by means of which the growing embryo is attached to the placenta. By means of blood-vessels in the umbilical cord the blood of the embryo is carried to the placenta, where it circulates in minute branching processes that are exposed to the blood of the mother, by means of which its supply of oxygen and food material is replenished, and the waste materials brought from the embryo are got rid of. At the end of pregnancy the placenta is thrown off as the after-birth, after the child itself has been expelled.

Placenta, in botany, a ridge of cellular tissue at the inner or ventral suture of a carpel, to which the ovules or seeds are attached either



Sections of Ovaries showing Forms of Placentations

1, Parietal placentation 2 and 3, Central or axile placentation. 4, Free-central placentation. a, Dorsal suture. b, Ventral suture. p, Placenta.

immediately or by stalks (funicles), as in the pod of the pea. The placenta is formed on each margin of the carpel, and is therefore essentially double. When the pistil is formed by one carpel, the inner margins unite in the axis, and usually form a common placenta. When the pistil is

composed of several carpels, there are generally separate placentas at each of their margins. The term *parietal placenta* is applied to one not projecting far inwards, or one essentially constituted of the wall of the seed-vessel. The form of placentation forms an important distinction between the various orders of plants.

Placentitis is inflammation of the placenta, and may be acute or chronic. The acute form frequently arises as a result of infection spreading from the membranes which cover the foetus in utero. If severe, this will cause the death of the foetus, and probably result in abortion. The chronic form may be due to tuberculosis or syphilis.

Placoid, a term used to designate a variety of scales covering the bodies of the Elasmobranchii (sharks, skates, rays, &c.), the Placoidae of Agassiz. These structures consist of detached bony grains, tubercles, or plates, of which the latter are not uncommonly armed with spines. They resemble teeth in structure, and the smaller ones are often termed 'dermal denticles'.

Plagioclase, a name for all the feldspars that crystallize in the triclinic system, and thus have their two cleavages oblique (Gr. *plagios*) to one another. Repeated lamellar twinning is characteristic.

Plagios'tomi (Gr. *plagios*, oblique, *stoma*, mouth), an order of fishes of the sub-class Elasmobranchii. The skeleton is cartilaginous; the mouth a transverse slit, situated on the under surface of the head; and the teeth numerous. The Plagios'tomi include sharks, dog-fishes, rays, saw-fishes, &c.

Plague is an acute infectious disease caused by the bacillus pestis, and occurs in two chief forms, the bubonic and the pneumonic. It is a disease of great antiquity, and was apparently present in ancient Egypt, also probably in the empires of Asia Minor, and there are records of the plague of Athens and of an outbreak in the reign of Marcus Aurelius. From the great plague in the days of Justinian in the sixth century down to the middle of the seventeenth century epidemics of varying severity occurred throughout Europe. The most disastrous of these was the famous 'Black Death' of the fourteenth century, which spread over Europe and destroyed one-fourth of the population. In the seventeenth century the Great Plague of London caused the death of 70,000 people within the city. During the eighteenth and nineteenth centuries it gradually became much rarer, till it had all but disappeared, except for some parts of China and North-West India, when again in 1894 there was a fresh outbreak at Hong-Kong, from which seaport it was spread to Japan, Australia, South and North America, Egypt, South Africa, West Indies, and to some

European ports, where there were slight outbreaks. It is now definitely established that the disease is spread to man by the bite of the rat-flea which has been previously living on an infected rat. Rats are very susceptible to plague, and the wide distribution of the last outbreak was due to infected rats being carried by shipping practically all over the world.

In any outbreak, or as a prevention to an outbreak, the most important factor is the destruction of rats, and especially those infected or liable to be so. The disease will never make serious headway in countries where rats and human beings do not occupy the same house, but in the East, where there are still devastating outbreaks, this condition widely exists. Of the two types, the more common is the bubonic, and the outstanding feature is a bubo or inflamed lymphatic gland. This may form an abscess and the condition remain local, in which case the patient probably recovers, or a general septicæmia may result and the patient dies. The pneumonic type is a very acute plague pneumonia, and as the lungs are affected, with each cough the patient spreads millions of bacilli into the atmosphere, hence its extreme infectivity. It is probably the most infectious condition known. The virulence of this type is very high, as nearly every case dies. Various curative serums have been tried, but none has given favourable results; but prophylactic vaccine is used on a very large scale in the East, and is thoroughly established as a preventive agent. When an epidemic threatens, the whole population should be inoculated.

Plaice (*Pleuronectes platessa*), a common flat-fish, largely used as food, which attains an average length of 12 or 18 inches. The dark or upper side is coloured brown, spotted with red or orange; the body is comparatively smooth; the ventral fins are situated on the throat, and are thus jugular in position; the mouth is of small size, and provided with minute teeth. These fishes are all 'ground-fishes', that is, feed and swim near the bottom of the sea. They are caught chiefly by means of trawl-nets.

Plain, one of the positive land forms. Plains receive a variety of names in different countries, as *steppes* in Russia and Asia; *savannas*, *prairies*, *pampas*, &c., in America. See *Geography*, under *Land Forms*, sect. i (a).

Plainfield, a city of New Jersey and residential suburb of New York City, United States, in Union county; served by the Central of New Jersey and electric railways. There are varied manufactures. Plainfield district was settled in 1684, but the township was only founded in 1847, and it became a city in 1867. Pop. (1920), 27,700.

Plain-song is the earliest form of art-music, and was at its zenith in the fifth and sixth cen-

turies. It was inevitably purely melodic in its nature, since harmonic treatment in music had still to be thought of and slowly elaborated, but with the simple means at its command it reached in a comparatively short time a very high degree of artistic excellence, and when properly rendered has great powers of eloquence even at the present day. It is further distinguished from the music of to-day by its freedom from the rhythmic control of the bar-line and the cadence, both of which exercise a somewhat despotic influence in harmonic music. This *unmeasured* character constitutes a real difficulty for the modern musician who would render plain-song as it should be sung, since the 'tyranny of the bar-line' is all-pervading; but the present tendency in music is markedly towards a greater rhythmic freedom, and the near future may bring to harmonic music that plasticity which is one of the most expressive elements in true plain-song. Then plain-song itself may come into that wider favour to which it is entitled by its beauty and expressive power. At present its true value is known and appreciated by comparatively few. All early melody music which is unmeasured is plain-song, but the term is more particularly associated in the minds of musicians with the music of the early Roman Catholic Church. It was, naturally, written in the old modes or early forms of the scale.

Plan, in architecture, a drawing showing the design of a building, a term chiefly used in reference to horizontal sections showing the disposition of the walls and various floors of the building, and of the doors and windows, &c.; but also applied to elevations and vertical sections. A *geometrical plan* is one wherein the several parts are represented in their true proportions. A *perspective plan* is one the lines of which follow the rules of perspective, thus reducing the sizes of the more distant parts. The term is also applied to the draught or representation on paper of any projected work, as the *plan* of a city or of a harbour.

Planarians, a group of soft-bodied flatworms, of the class Turbellaria, mostly oval or elliptical in shape, and not unlike the foot of a gasteropodous mollusc. Some are aquatic in their habits, occurring in fresh water or on the sea-shore, but land planarians abound in the warmer parts of the globe, some being of large size (6 to 9 inches long). The male and female organs are united in the same individual, and the process of reproduction may be either sexual, by means of true ova, or non-sexual, by internal gemmation or transverse fission.

Planchette, a thin heart-shaped piece of wood supported on two castors at the ends of the base, and on an ordinary pencil at the apex. If the finger-tips be placed upon the

instrument, the pencil may readily be made to trace characters even without conscious movement on the part of the operator. When used by some persons, it seems to begin to move of its own accord after a little while, and if the person wishes, for instance, to have an answer to a certain question, writing may be formed on the sheet of paper on which the instrument is placed, containing something more or less pertinent to the matter, but probably never anything that is not more or less consciously in the operator's mind. It has figured much in spiritualistic séances, where it has afforded disembodied spirits an opportunity for exercising their literary talent, and it has enjoyed some popularity as a drawing-room entertainer.

Plane. See *Tools*.

Planet, a celestial body which revolves about the sun as its centre (*primary planets*), or a body revolving about another planet as its centre (*secondary planets, satellites, or moons*). The known *major planets* are, in the order of their proximity to the sun, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. These bodies shine by reflected sunlight. Mercury, Venus, Mars, Jupiter, and Saturn were known to the ancients. Uranus was discovered through observation by Herschel in 1781, while the discovery of Neptune was the result of pure intellectual work, the calculating of Leverrier and Adams (1845). The planetoids or asteroids are small bodies discovered since the beginning of the nineteenth century, mainly between the orbits of Mars and Jupiter. The number of these asteroids is annually increased by fresh discoveries; over 1000 are now known. Mercury, Venus, the Earth, and Mars closely resemble one another in many respects. They are all of moderate size, with great densities, the earth weighing as much as five and a half times an equal bulk of water. Jupiter, Saturn, Uranus, and Neptune, on the other hand, are of enormous size, of small densities, Saturn weighing less than an equal bulk of water, and probably possess a high temperature. The most colossal of the planets is Jupiter; its volume exceeds that of the earth about 1300 times. Saturn is next in size. Mars, Jupiter, Saturn, Uranus, and Neptune, being outside the earth's orbit, are sometimes called the *superior planets*; Venus and Mercury, being within the earth's orbit, are called *inferior planets*. The family of major planets has also been subdivided into *intra-asteroidal* planets—Mercury, Venus, the Earth, Mars; and *extra-asteroidal* planets—Jupiter, Saturn, Uranus, and Neptune, the character of the two being very different, as above described. The major planet which approaches nearest to the earth is Venus, the least distance in round

numbers being 25 millions of miles; the most distant is Neptune, least distance 2675 million miles. We give here a comparative table of the planets; see also the separate articles.

on exposure to the weather. The Oriental plane (*P. orientālis*) resembles the preceding, and is plentiful in the forests of Western Asia. The *P. orientālis* and *P. acerifolia*, from being able

	Mean Distance from the Sun.	Distance from the Earth.		Time of Revolution round the Sun.	Time of Rotation on Axis.		
		Greatest.	Least.				
	Miles.	Miles.	Miles.	Mean Solar Days.	h.	m.	s.
Mercury	36,000,000	134,800,000	50,900,000	87.9692	?	?	?
Venus	67,200,000	161,200,000	24,500,000	224.7007	?	?	?
The Earth	92,900,000			365.2563	23	56	4
Mars	141,500,000	248,600,000	34,500,000	686.9704	24	37	23
Jupiter	483,300,000	599,500,000	367,200,000	4332.5848	9	55 ¹	
Saturn	886,100,000	1,027,200,000	745,100,000	107.592197	10	30 ²	
Uranus	1,782,000,000	1,956,900,000	1,607,300,000	30688.3900	10	45 ²	
Neptune	2,792,000,000	2,909,100,000	2,675,000,000	60181.1132	?	?	?

¹ About 5 minutes less in equatorial regions. ² Approximate; probably varies considerably in different latitudes. ³ Deduced from shift of spectral lines.

Plane Tree (*Platanus*), a genus of trees, nat. ord. Platanaceæ. *P. occidentālis*, the American



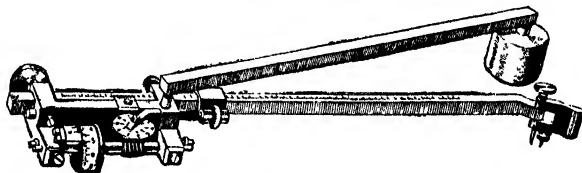
Western Plane (*Platanus occidentālis*)

plane tree or button-wood (the *sycamore* or *cotton tree* of the West), abounds in American forests, and on the banks of the Ohio attains sometimes a diameter of from 10 to 14 feet, rising 60 or 70 feet without a branch. The bark is pale-green and smooth, and its epidermis detaches in portions; the fresh roots are a beautiful red; the leaves are alternate, palmated, or lobed; and the flowers are united in little globular, pendent balls. The wood in seasoning takes a dull red colour, is fine-grained, and susceptible of a good polish, but speedily decays

to withstand the deleterious influences of a smoky atmosphere, are among the trees most suitable for planting in towns. The *Acer pseudo-platanus*, the common sycamore or greater maple, is called in Scotland the plane tree.

Planimeter, an instrument for measuring areas, no matter how irregular, which is used extensively in engineering calculations. The determination of the mean pressure on an engine piston from the indicator-diagram may be cited as an example of its use. These diagrams are not of any regular form, but the area can readily be obtained by the use of the planimeter, and the mean height deduced by dividing the area by the measured length. Amsler's planimeter has two arms, one of which is held in a carriage which is hinged to the other. At the extreme end of the one arm a needle-point is provided as a centre about which the instrument can be moved when in use, and at the extreme end of the other arm the tracing-point is fixed.

The area to be measured is traced out in a clockwise direction. A graduated revolving wheel records the area of the figure in units, which depend upon the position of the carriage. Marked positions on the tracer-arm of the planimeter indicate where the carriage must be fixed to work with



Planimeter

particular units. For the theory of the instrument see B. Williamson, *Integral Calculus*.

Planing-machine. See *Machine-tools*.

Plankton and Nekton, collective terms applied to assemblages of certain aquatic organisms. Plants and animals that float or drift at or near the surface of the sea or of fresh water, are known as *plankton*, while the actively swimming and usually predacious animals that do not descend to great depths make up the *nekton*. It may be added that deep-water forms are collectively called *benthos*.

Plankton.—The plants of this assemblage include not only large forms, such as the gulf-weed of the Sargasso Sea, but vast numbers of microscopic species, of which the most interesting are the flinty-shelled diatoms, which serve as food to the shoals of minute crustacea that constitute the aliment of many fishes, and are the ultimate source of the mysterious vitamins that give one of its valuable properties to cod-liver oil. Plankton animals are usually transparent or translucent, and many of them are buoyed up by bubbles of gas or by oil globules. Among them are many Protozoa, including various Foraminifera, and when these die their calcareous shells settle down on large areas of the sea-floor to make up calcareous 'ooze', which when consolidated and raised above the surface becomes chalk. The phosphorescence of the sea is largely due to the night-light animalcule (Noctiluca), and other floating Protozoa are the ray animalcules (Radiolaria) with flinty skeletons. Plankton also includes many of the jelly-fishes, some annelids, echinoderm larvæ, and shoals of Crustacea, especially the fork-footed forms (Copepoda), that constitute the staple diet of the herring and some other valuable food-fishes. Mollusca are also present, especially the wing-footed snails (Pteropoda), of which vast shoals are swallowed wholesale by the whalebone whale. Among the primitive vertebrates we find various ascidians, such as the salps (Salpa) and the phosphorescent fire-cylinders (Pyrosoma), while the floating eggs of most marine fishes belong to the plankton, as do the transparent larvæ that hatch out from them. Many elaborate investigations have been and are being made on plankton, and these are of great importance with regard to fisheries. Quantitative methods, first devised by Hensen, but now much improved, have given remarkable results. It has been calculated, for example, that the plankton of the 16 square miles of the Eckernförde (in the Baltic) contains something like 15,600 billion Copepoda, enough to feed 534 million herrings for a year.

Nekton.—The most important animals of this assemblage are squids and cuttle-fishes; a great many fishes; some of the aquatic birds, of which penguins are the most remarkable; and various aquatic mammals, including seals and sea-

lions (Pinnipedia), Sirenia, and Cetacea. The birds and Pinnipedia, of course, only partly belong to the nekton, as they spend part of their time on land, while birds are largely creatures of the air.

Plantagenet, a surname first adopted by Geoffrey, Comte d'Anjou, and said to have originated from his wearing a sprig of broom (*plante de genêt*) in his cap. This name was borne by the fourteen kings (from Henry II to Richard III) who occupied the English throne from 1154–1485. In 1400 the family was divided into the branches of Lancaster (Red Rose) and York (White Rose), and from their reunion in 1485 sprang the House of Tudor. See *England*.

Plantagin'ceæ, or **Plantagina'ceæ**, the plantains, a small natural order of gamopetalous dicotyledons. It consists of herbaceous, rarely suffrutescent, plants, with alternate or radical, rarely opposite, leaves, and inconspicuous flowers on scapes arising from the lower leaves. The rib-grass or rib-wort (*Plantago lanceolata*), the root and leaves of which were formerly used in medicine as astringents, is a common type found all over Europe.

Plantain (*Plantago major*), or **Great Plantain**, a common weed, the leaves of which are all radical, oval, and petiolate, and have rising from amongst them several long cylindrical spikes of greenish inconspicuous flowers. The root and seed are still occasionally employed in the treatment of diarrhœa, dysentery, and external sores; the seeds are also collected for the food of birds.

Plantain, or Plantain Tree, the type of the nat. ord. Musaceæ. *Musa paradisiaca*, a native of the East Indies, is cultivated in almost all tropical countries. The stem is soft, herbaceous, 15 to 20 feet high, with leaves often more than 6 feet long and nearly 2 feet broad. The fruit grows in clusters, is about 1 inch in diameter, and 8 or 9 inches long. The stem dies down after fruiting; but the root-stock is perennial, and sends up numerous fresh shoots annually. It is easily propagated by suckers. The banana (q.v.) is a closely allied variety or species. Their fruits are among the most useful in the vegetable kingdom, and form the entire sustenance of many of the inhabitants of tropical climates. A dwarf variety, *M. chinensis*, produces a fruit in European hot-houses. The fibres of the leaf-stalks of *M. textilis* of the Philippine Islands supplies Manila hemp or abaca, from which cordage of the strongest character is made, the finer fibres being used in making cloth.

Plantain-eaters, a group of perching birds, family Musophagidæ. The genus *Musophaga* of tropical Africa includes the most typical forms. These birds chiefly feed upon the fruit of the banana and plantain trees. The base of the bill

appears as a broad plate covering the forehead. The plumage exhibits brilliant coloration. The members of the genus *Corythaix* or *Turacus* possess a bill of ordinary size and conformation, and feed on insects in addition to fruits.

Plant-anatomy, the investigation of the internal structure of plants, carried out mainly by the microscopic examination of very thin sections cut in various planes across the organ it is desired to study. As a rule the material has to be previously hardened by preservation in alcohol, and the sections 'stained' with aniline or other dyes in order to bring out the structure more clearly. The facts discovered by the anatomical method are of the greatest interest both to the plant-physiologist and to the student of evolution; they have also a practical bearing on the identification of drugs, timbers, adulterations in food-stuffs, &c. See *Botany*.—**BIBLIOGRAPHY**: G. F. Scott Elliot, *First Lessons in Practical Botany*; F. O. Bower and D. T. Gwynne Vaughan, *Practical Botany for Beginners*; G. Haberlandt, *Physiological Plant-anatomy*.

Plantation, a term formerly used to designate a colony. The term was applied to an estate or tract of land in the Southern States of America, the West Indies, &c., cultivated chiefly by negroes or other non-European labourers, and the general term *plantation* is used throughout Malaya, Oceania, India, and Africa, &c., to cultivated areas, confined principally to tea, palm, rubber, cotton, sugar, tobacco, and rice.

Plant-breeding, as a science, is a comparatively recent development, though agriculturists, seedsmen, and gardeners have from the earliest times endeavoured to improve useful and ornamental plants by selecting the most promising varieties and strains. Institutes for scientific research in this branch of applied botany were established as long ago as 1886 in Sweden and Denmark, where their work has effected a remarkable improvement in the principal crops. England, Scotland, and Wales now each possess a recognized plant-breeding station, and similar institutions are to be found in many of our dominions and colonies, in most European countries, and in the United States.

Plant Enzymes. The nature and classification of enzymes in general have been dealt with under *Fermentation*. A few examples of their occurrence in plants may be given here. *Cytases* transform the hemi-celluloses of seeds into sugar. *Lipases* act on fatty oils, with formation of glycerine (a good food-material) and fatty acids; they are found especially in germinating oily seeds, such as castor-oil bean. *Proteases* decompose proteins into simpler compounds; an interesting occurrence of these is in carnivorous plants, such as *Nepenthes* and *Drosera*. Among

glucoside-splitting enzymes is the *emulsin* of bitter almonds, which breaks up amygdaline into glucose, prussic acid, and benzaldehyde. The above are all *hydrolyzing enzymes*, which break down complex substances by introducing molecules of water, and play an essential part in the activities of every living cell. *Zymase* of yeast, which effects the alcoholic fermentation of sugar, is an example of a *fermenting enzyme*. *Oxidizing enzymes* are widely distributed in plants, the browning of a cut apple being a familiar example of their action.

Plantigráda, or **Plantigrades**, carnivorous animals in which the whole or nearly the whole sole of the foot is applied to the ground in walking. This section includes the bears, raccoons, coatis, and badgers. Carnivora which, like the weasels and civets, use only part of the sole in walking, are termed *semi-plantigrada*.

Plant-pathology, the study of disease in plants, one of the most important of the practical aspects of botanical science. All civilized countries now maintain large staffs of experts and elaborately equipped stations for research on diseases of economic plants, especially on those due to fungoid and bacterial parasites, which cause enormous material loss, largely preventable by the application of appropriate remedial measures.—**BIBLIOGRAPHY**: Marshall Ward, *Diseases of Plants*; G. Massee, *Textbook of Plant-diseases*.

Plant-physiology, that branch of botany which deals with the vital activity of plants, i.e. with the structure and properties of their living substance or protoplasm, and with the various 'functions', such as the intake and output of water, carbon assimilation and nutrition generally, respiration, growth, movement, &c. See *Botany*.—**BIBLIOGRAPHY**: Reynolds Green, *Vegetable Physiology*; L. Jost, *Lectures on the Physiology of Plants*.

Plant-symbolism. In ancient Egypt certain marsh plants and other curative herbs were supposed to have had origin from the tears of beneficent deities, and certain poisonous plants from the tears of evil demons. It was thus believed that the active principle of the curative or poisonous herb was the 'life substance' of a supernatural being. Celtic curative herbs were originally connected with deities. The dandelion is still 'the plant of Bride' (Brigit). Some plants, like 'St. John's Wort' (St. Columba's herb), were taken over by early missionaries, while the metrical plant-charms were given a Christian significance, and plants were blessed "in the name of the Father, Son, and Holy Ghost". Herbs were gathered with ceremony. When the wild hyacinth, called in Gaelic *lus an tálaidh* ('the enticing plant', i.e. love-causing plant), was sought for, one had to face the

south and draw the plant out of the ground immediately before sunrise. The mugwort (a species of *Artemisia*) was a plant which "Christ had among strangers"; it protected and strengthened travellers and cured women's diseases. Other plants protected individuals and houses against witchcraft, the evil eye, &c. There are many links between the herb-lore of Britain and that of the Continent. In Greece the mugwort was connected with the goddess Artemis. Dr. Rendel Harris, in his *Ascent of Olympus*, has shown that the goddess was not only the giver of the plant but a personification, in one of her aspects, of the plant itself. Mistletoe was regarded as an 'all heal'. It was used in religious ceremonies in Europe, and across Asia as far as east Kamchatka. In Gaelic lore the parasitic plant is regarded as the 'king', because it "holds captive . . . all tough trees". Ivy, which was sacred, had a similar reputation, and was carved on aniconic pillars in Europe and Asia, while witch doctors made use of it for medicinal purposes. Ivy-clad pillars were gods in Siberia, as in Greece. The mandrake was a love-plant, and one used to cure women's diseases in Asia and Europe. In China it is called *ginseng*, and the Chinese import it from Korea. The Greeks connected it with their love-goddess Aphrodite. It was supposed that the mandrake shrieked when pulled out of the ground. A dog was prompted to pull it, and the animal died immediately afterwards. The Homeric 'moly', the 'charmed herb' given by the god Hermes to Odysseus to protect him against the spells of Circe, is believed to be the mandrake. In Northern Europe the place of the mandrake was taken by the apple, which was also a love-enticer and a fruit of longevity. Mandrake lore was attached likewise to rowan berries, which "make evil charms of no avail", as does the Homeric moly.

Rowan, ash and red threed (thread)
Gar the witches tyne their speed.

The custom of adorning walls with holly, ivy, and mistletoe at Christmas survives from the time when houses were charmed against attack by supernatural beings and witches.

Plasencia, a walled city in Spain, Estremadura, almost surrounded by the River Yerte, 120 miles w.s.w. of Madrid. Its cathedral, episcopal palace, and ruined towers are the chief objects of interest. Pop. 9500.

Plasma, a green variety of chalcedony, which, especially in ancient times, was used for ornamental purposes.

Plasmodiophora. See *Fingers-and-toes*.

Plassey, a village in Bengal, on the Bhagirathi. Here, on 23rd June, 1757, Colonel, afterwards Lord Clive, with 900 Europeans and 2100 sepoy,

defeated Suraj-ud-Dowlah with an army consisting of 50,000 foot and 18,000 horse, and laid the foundation of the British Empire in India.

Plastering is the art of covering the surface of masonry or wood-work with a plastic material in order to give it a smooth and uniform surface, and generally in interiors to fit it for painting or decoration. In plastering the interior of houses the first coat is generally of lime, thoroughly slacked, so as to be free from any tendency to absorb moisture, and mixed with sand and cow's hair. For the purpose of receiving this coat the wall is generally first covered with laths or thin strips of wood, with narrow interstices between. The face of the first coat, which should be of considerable thickness, is trowelled, or indented with cross-lines by the trowel, to form a key for the finishing coats. The second coat is applied to this when it is thoroughly dried. It is rubbed in with a flat board so as thoroughly to fill the indentations and cover the unequal surface of the first coat with a smooth and even one. In plastering walls great care must be taken to have the surface perfectly vertical. The setting coat, which is of pure lime, or for mouldings or finer work of plaster of Paris or stucco, is applied to the second coat before it is quite dry. A thin coating of plaster of Paris is frequently applied to ceilings after the setting coat.

Plaster of Paris, the name given to gypsum (q.v.) when calcined at about 400° F. and ground. It is used for taking casts, for decorative mouldings, and in some parts of the European continent for flooring, where it is treated after laying with zinc and iron sulphates. If one part of powdered gypsum be mixed with two and a half parts of water, a thin pulp is formed, which after a time sets to a hard, compact mass. By adding a small quantity of lime to the moistened gypsum, a very hard marble-like substance is obtained on setting.

Plasters are sticky, adhesive applications which are chiefly used to give mechanical support, to protect cuts and abrasions, or to fix dressings, but which may be impregnated with some medicinal substance to produce a local reaction on the skin, e.g. belladonna, cantharides, &c. The basis of most plasters is lead, isinglass, or resin, and plasters of the latter two stick more firmly than the older lead plaster. Plasters are always applied spread on a cloth.

Plastic Clay, in geology, a name given to one of the lower beds of the Eocene system in France and England, from its being used in the manufacture of pottery. It is a marine deposit.

Plata, Rio de la (River of Silver), or **River Plate**, runs for more than 200 miles between the Argentine Republic and Uruguay, and is not, strictly speaking, a river, but rather an estuary,

formed by the junction of the Rivers Paraná and Uruguay. It flows into the Atlantic between Cape St. Antonio and Cape St. Mary, at which point it is 170 miles wide. On its banks are the cities and ports of Montevideo and Buenos Ayres. Navigation is hampered in some parts of the river by shallow water and sand-banks. It was discovered in 1515 by Juan Diaz de Solis, and called Rio de Solis; it owes its present name to the navigator Cabot.

Platæa, a city of ancient Greece, in Bœotia, now wholly in ruins. It has a permanent place in history on account of the great battle which was fought in its vicinity in Sept., 479 B.C., when 100,000 Greeks under Pausanias of Sparta defeated about thrice that number of Persians under Mardonius.

Platanis'ta, a freshwater dolphin, differing chiefly from the true Delphinidæ in its blow-hole being a longitudinal instead of transverse fissure. It is represented by a single species (*P. gangetica*), which inhabits the estuary of the Ganges. An allied form (*Inia geoffrensis*) inhabits the Amazon.

Plat'anus. See *Plane Tree*.

Plate, the term generally applied to products of the gold- and silversmith's art other than coins or articles of personal ornament. That the art of working in gold was early known is proved by the discovery at Stonehenge of a sword of the Bronze Age (now in the Devizes Museum), in which the hilt is adorned with marvellously minute and elaborate work in that metal. Gold was, in early times, more generally in use than silver, the latter metal being less often found in a pure state, and also being more difficult to work. The Biblical account of the construction and adornment of Solomon's temple furnishes details of elaborate sacred plate, and the Homeric heroes carried shields and armour made of gold and richly worked. Greek knowledge of the goldsmith's art, as also the supply of precious metal, was drawn from the East. Phidias and the somewhat later craftsman Mentor may be named as prominent Greek artists of this class. The Romans, though not themselves excelling as artists, had the power and wealth to command the services of Grecian workers. In 1868 a quantity of splendid Roman plate, dating from the first to the fourth centuries of our era, and including silver dishes, stew-pans, cups, vases, &c., was discovered at Hildesheim, in Hanover; while under the imperial rule articles of household luxury were often of great size and value, silver centre-dishes weighing 500 lb. being seen upon the tables of the rich. Byzantine art of this class was in a flourishing condition from the fourth to the eleventh centuries. About the latter date a great revival in metal-working swept over Western Europe, including Britain. Such abbeyes as those of Tours, in France, and Ely,

in England, became centres of plate-production, the workers being at once artists and craftsmen. Monastic and church architecture suggested many favourite designs, diversified by the introduction of monstrous and supernatural figures. Of monastic production was probably the beautiful twelfth-century candlestick of silver alloy made in Gloucester and now at South Kensington. By the thirteenth century goldsmiths' guilds began to appear, plate became secular rather than religious in its origin, as well as in its character and use, and it assumed a prominent place upon the tables of the wealthy and noble. The salt-cellar, forming a dividing-point between the family and guests above, and the menials and dependents below, offered a field for decoration, as did the central *nef*, a model ship on wheels, laden with spices or comfits. In the fourteenth and fifteenth centuries connoisseurs secured possession of the productions of the della Robbia and of the Arditi of Florence; still later of that unsurpassed blend of artist and scoundrel, Benvenuto Cellini. To vie with these masters of the south, Northern Europe offered the work of Augsburg and Nürnberg. Henry VIII possessed a fine display of plate, nor did Holbein disdain to design gold cups. In Britain, during recent times, the artist rarely executes his own conceptions, leaving the actual craftsmanship to a merely faithful mechanic; perhaps as a consequence of this division of the art, the nineteenth century can show but little better plate than that seen in race-cups and similar trophies. Among the truest taste surviving is that found in the East, where Kashmir and Benares, with other Indian cities, still produce some really high-class work. For *Hall-marks* on plate, see separate heading.—**BIBLIOGRAPHY**: Benvenuto Cellini, *Treatises on Goldsmithing and Sculpture* (Ashbee's translation, 1898); J. H. Pollen, *Gold and Silversmith's Work* (1875); Henry Wilson, *Silver Work and Jewellery* (1903); also works by J. W. Caldecott and W. J. Cripps.

Plateau, in physical geography, one of the positive land forms. See *Geography* ('Land Forms', sect. i (b)).

Plating consists of covering the surface of one metal with another metal, generally with the object of affording greater protection from attack by noxious gases or other corroding agencies. The process was formerly largely used to supply a surface of precious metal, such as silver or gold, on to a base of an inferior metal, such as copper or German silver. The process consisted in fusing a slab of silver on to one or both sides of the base metal, and afterwards rolling down the compound slab into sheets of suitable thickness. Since the introduction of electro-plating methods, this process has largely fallen into disuse, although it is still used to some extent for covering steel

with copper and for similar purposes. See *Electro-plating*; *Galvanized Iron*.

Platinum, one of the metals occurring in the mineral *native platinum*. This occurs mostly in small irregular grains, generally contains a little iron, and in addition iridium, osmium, rhodium, palladium, ruthenium (hence called the 'platinum metals'), and also sometimes copper, chromium, and titanium. It was first obtained in Peru, and has since been found in various other localities, such as Canada, Oregon, the West Indies, Brazil, Colombia, Borneo, &c., but the chief supply of platinum comes from the Ural Mountains. Platinum was there discovered in beds of auriferous sands in 1823, and has been worked by the Russian Government since 1828. Pure platinum is almost as white as silver, takes a brilliant polish, and is highly ductile and malleable. It is the heaviest of the ordinary metals, and the least expansive when heated; specific gravity, 21.53 rolled, 21.15 cast. It undergoes no change from the combined agency of air and moisture, and it may be exposed to the strongest heat of a smith's forge without suffering either oxidation or fusion. It fuses in the flame of the oxyhydrogen blowpipe at a temperature of 1710° C., and may readily be welded at a red heat. Platinum is not attacked by any of the pure acids. Its only solvents are chlorine and nitro-hydrochloric acid (*aqua regia*), which act upon it with greater difficulty than on gold. In a finely divided state (spongy platinum and platinum black) it has the power of absorbing and condensing large quantities of gases, and in this form is also largely used as a catalytic agent, causing certain chemical reactions to take place without apparently taking part in them. On account of its great infusibility, and its power generally of withstanding the action of chemical reagents, platinum is much used as a material for making vessels to be used in the chemical laboratory. Crucibles, evaporating dishes, &c., are very often made of platinum. The salts of readily reducible metals, such as silver, lead, tin, &c.; solid alkalis, especially baryta; or oxidizing agents, such as nitre, should not be fused in platinum vessels. It is also used to a certain extent as a setting for jewels. The useful alloys of platinum are not numerous. With silver it forms a tolerably fusible white alloy, malleable and brilliant when polished, used by dentists and commonly known as dental alloy. Gold, at a forge heat, alloys with platinum in all proportions. Alloyed with iridium (a rare metal of the same group) it possesses an excellent and unalterable surface for fine engraving, as in the scales of astronomical instruments, &c. This alloy has also been adopted for the construction of international standards of length and weight. Mercury, by

trituration with spongy platinum, forms an amalgam at first soft, but it soon becomes firm, and has been much used in obtaining malleable platinum. A coating of platinum can be given to copper and other metals by applying to them an amalgam of spongy platinum and 5 parts of mercury; the latter metal is then volatilized by heat. Lead combines with platinum readily; and iron and copper in like manner. The last-mentioned, when added in the proportion of 7 parts to 16 parts of platinum and 1 part of zinc, and fused in a crucible under charcoal powder, forms the alloy called artificial gold. An alloy of platinum, iridium, and rhodium is used for making crucibles, &c. It is harder than pure platinum, is less easily attacked by chemical reagents, and not so readily fusible. Platinum wires, in conjunction with wires of platinum alloy containing 10 per cent of rhodium or iridium, are largely used for the hot junctions of thermo-electric pyrometers.

Plato, ancient Greek philosopher, and the founder of one of the great schools of Greek philosophy, was born at Athens, or near it on the Island of Ægina, in 429 B.C. (87th Olympiad, on the seventh day of the month Thargelion), and died in 347. He belonged to an aristocratic family, and hence, perhaps, his contempt for democracy. His father, Ariston, is said to have been a descendant of Codrus, and his mother, Perictione, a relation of Solon. He received a liberal education, obtained prizes at the Olympic and Isthmian games, and studied philosophy under Cratylus, a disciple of Heraclitus, who had maintained that all things are in a state of flux, a teaching which he never forgot. He also studied music, painting, and poetry, and was preparing a tetralogy for the theatre when, about his twentieth year, he came under the influence of Socrates. The result was that he threw his dramatic manuscripts into the fire and henceforth devoted himself to philosophy. His own name was Aristocles, and it was Socrates who called him Plato on account of his wide forehead and broad shoulders. For ten years, until the death of Socrates (399 B.C.), he was a constant and favourite pupil of the latter. After the death of Socrates, Plato is supposed to have left Athens with a view to improving his mind by travel. He is said to have retired first to Megara, in company with Euclid and the majority of the Socratic philosophers, and then to have visited Cyrene, where he studied under Theodorus, the mathematician. He visited the courts of Dionysius the Elder and of Dionysius the Younger in Sicily, and is also said to have travelled in Egypt. About 389 or 388 B.C. he returned to Athens and began to teach his philosophical system in a gymnasium

known as the Academy. He had a patrimony sufficient for his wants, and taught without remuneration.

Works.—The reputed works of Plato consist of dialogues and letters, but the latter are now regarded as spurious. The genuineness of most of the dialogues is generally admitted, although their chronology is a matter of uncertainty. The first attempt at a critical classification was made by Schleiermacher, who adopted an arrangement into three divisions, according to the leading doctrines he believed they were intended to teach. The chief works in the first section are: *Phædrus*, *Protagoras*, *Parmenides*, *Lysis*, *Laches*, *Charmides*, and *Euthyphron*; in the second, *Theætetus*, *Sophistes*, *Politicus*, *Phædo*, *Philebus*, *Georgias*, *Meno*, *Euthydemus*, *Cratylus*, and *Symposium*; in the third, the *Republic*, *Timæus*, *Critias*, and the *Leges* or *Laws*. Hermann attempted to make out a chronological arrangement, and other scholars, especially Lutoslawski, have attempted various theories of constructive arrangement. These schemes in general proceed on the assumption that each dialogue, being an artistic whole, forms a link in a chain. Grote and others, however, do not admit that Plato followed any plan, either artistic or didactic. Apart from their philosophical teaching, the dialogues of Plato are admirable as works of literature, especially for their dramatic truthfulness, and exhibit Greek prose in its highest perfection. In all of them Socrates (idealized) appears as one of the speakers. They contain also lively and accurate accounts of previous systems of Greek philosophy and their teachers, introduced not merely for historical purpose, but incidentally to the analysis of their opinions.

Plato's Philosophy.—The philosophy of Plato is one of the grandest efforts ever made by the human mind to compass the problem of life. The great aim of philosophical teaching was, according to Plato, that of leading the mind of the inquirer to the discovery of truth rather than that of imparting it dogmatically. Oral teaching was therefore superior to writing. This accounts for the conversational form given to most of Plato's works. He originated the division of philosophy into the three branches of ethics, physics, and dialectics, though these names were first applied by his disciple Xenocrates. We have said that Plato had never forgotten the teaching of Heraclitus, that everything is in a state of flux. From Socrates, however, he had learned the importance of universals, and he came to the conclusion that existence supposes superior principles of unity and perfection. Above eternally changing, imperfect sensible things there must be a stable reality. In the eternal reality of things there must be a principle which contains in a superior form

all the perfections which are so imperfectly realized in man or animal. Like Socrates, Plato employed the dialectical method, and by means of dialectics he rose to first principles, exact definitions, essentials, and universals, from which he judged particular cases. Like Socrates, he attached importance to the study of the inner man, and endeavoured to form general ideas under the form of definitions.

The Theory of Ideas.—The cardinal principle of Plato's dialectical system is the doctrine of ideas, but his method of developing his principles has left some room for doubt or misunderstanding as to what this doctrine really was. Differences upon the subject began early, and different opinions are still expressed by critics. This doctrine, however, so pervades the entire system of Platonic dialectics, ethics, and physics, of all of which it is the fertilizing or creative principle, that if we give a due attention to its place in each, we can hardly miss a substantially accurate conception of it. From a comparison of various statements which Plato has made respecting ideas, a theory of them may be traced in relation to the various parts of his system.

Respecting the historical origin of the doctrine of ideas, Aristotle has left an interesting statement, which renders it probable that it was during the lifetime of Socrates that it was first conceived. Plato, he says, derived from Cratylus, the Heraclitean, the doctrine that the sensuous is subject to perpetual change. This he ever afterwards maintained, and when he learned from Socrates of conceptions, which, when once rightly defined, remain for ever invariable, he believed that their counterparts must not be sought in the sensuous world, but that there must be other existences which were the objects of conceptual cognition, and these objects he named *ideas*. Euclid of Megara has also been credited with exercising a considerable influence on the development of his views.

The philosophical genesis of the doctrine of ideas is not uncertain. It was in the human mind and in the analysis of its conceptions that Plato found it. The word had been used before his time, and has been used since, to signify the mental image by which an object of sense is reproduced in the mind. This is not Plato's idea. Such an image is merely the concrete conception. Plato's idea is derived from an analysis of conception. It represents, as indicated in the passage in Aristotle above referred to, the immutable element in conception. Here, however, a misunderstanding is apt to arise from the terms employed in modern philosophy. It is common now to analyse conception or cognition into two elements, the universal or invariable, and the particular or variable; the former is the ego, or subject considered apart from the matter or

object of cognition. This distinction is not that of the Platonic analysis.

It is not the relation of the mind to the conception, but the particular conception itself, whether in or out of the mind, that is the subject of it. In this conception, in each such conception, Plato finds an immutable element which he calls its *idea*. This he illustrates in many ways, and in regard to a great variety of subjects. That which forms, perhaps, the basis on which the Platonic structure has been reared, and which best serves to illustrate its distinctive principle, is the case of opposite or contrasted conceptions. In the statement that Simmias is large in comparison with Socrates, but small in comparison with Phædo, we appear to view largeness and smallness as purely relative conceptions, since in the one case we predicate the one, and in the other case the other of the same individual. But when we subject these conceptions to the scrutiny of reason, we find that they cannot be wholly relative. The comparative implies the positive, for unless there were something absolute and immutable in the conception of largeness, it could not be compared with smallness or anything else. If the conception were transient in the individual mind, the comparison would be transient also, and an object which was conceived of at one time as relatively large in comparison with another, might be conceived of at another as relatively small in comparison with the same object; or if the conception varied in different minds, the ground of the comparison would vary in like manner. But largeness is always conceived of as bearing the same relation to smallness, and we mean the same thing in the above comparison when we say that Simmias is larger than Socrates, as when we say that Phædo is larger than Simmias. There must therefore be something positive in the conceptions both of largeness and smallness to allow of their being thus constantly opposed; but this cannot be the particular amount of largeness contained in Simmias, seeing he is large in the one case and small in the other. Hence Plato distinguishes between the concrete quality as conceived to exist in an object, and the *idea* of the quality. The former is *mutable*, the latter *immutable*; but the quality always partakes of the *idea*, otherwise it would cease to exist. Plato is thus the founder of objective idealism, i.e. of that system and conception of life which seeks the highest values not in sensible empirical reality, but in the ideals, the prototypes of perfect forms of imperfect and eternally changing reality. Whilst agreeing with the Eleatics that reality does not change (for *ideas* are immutable), he admits with Heraclitus that there is change in the world of experience or of phenomena. Such is the basis of the Platonic sphere of *ideas*.

True science, according to Plato, has to do with those material forms and imperfect intelligences which we encounter in our daily intercourse with men; but it investigates the nature of those purer and more perfect patterns which were the models after which all created beings were formed. These perfect types he supposes to have existed from all eternity, and he calls them the *ideas* of the great original Intelligence. As these cannot be perceived by the human senses, whatever knowledge we derive from that source is unsatisfactory and uncertain. Plato, therefore, maintains that degree of scepticism which denies all permanent authority to the evidence of sense. Having discovered or created the realm of *ideas*, he surveyed it throughout. He defined its most excellent forms as beauty, justice, and virtue, and having done so, he determined what was the supreme and dominant principle of the whole. It is the *idea* of the Good. The harmony of intelligence throughout its entire extent with goodness is, perhaps, the highest attainment of Plato's philosophy. His objective idealism differs to this extent from the theories of modern idealists, Kant, for instance, in so far as he allegorizes his *ideas*, gives them life and creative power, and seats them on thrones in places beyond the vault of heaven.

Ethics.—The ethical system of Plato was in direct dependence upon his dialectics, and will require little illustration. He believed that the *ideas* of all existing things were originally contained in God. These *ideas* were each the perfection of its kind, and as such were viewed by God with approval and love. God, Himself being infinitely good, was the object of all imitation to intelligent beings, hence the ethics of Plato had a double foundation, the imitation of God and the realization of *ideas*, which were in each particular the models of perfection.

Cosmogony.—Plato's cosmical theories stood professedly on a different foundation from his dialectics and ethics. Matter did not come within the scope of his dialectical analysis. He had accepted a preconceived view of it which excluded it from dialectical treatment; consequently it had no place in his world of *ideas* and no relation with God, upon whom they depended. He consequently gave it an existence independent of God as a formless, passive, inert mass without qualities or conditions. To his cosmical theories he attributed only probability, holding that the dialectical method, by which alone truth could be discovered, was applicable only to *ideas* and the discovery of moral principles. The most valuable part of Plato's cosmogony is its first principle, that God, who is without envy, planned all things that they should be as nearly as possible like Himself. He first made the soul of the world, which, being intermediate between the

sensible and the intellectual, forms a connecting-link between them. It is formed of two opposite principles, the one indivisible and immutable, the other mutable and divisible, and these are combined by an intermediate principle. To this soul He joined the material body. All things were created according to ideas, which were the perfection of each kind. Thus every individual in a species, for example, partakes of the idea of the species, but the individual is always inferior to the ideal. The soul of man, like the soul of the world, consists of three parts or elements. Plato attributes to it not only immortality but pre-existence. Sometimes this is predicated of the whole, sometimes only of the superior part. To the highest part of the soul, which has the head as its seat, he gives the cogitative powers and the desires appropriate to them; the intermediate part of the soul, having its seat in the heart, is distinguished by active impulses; the third part, with its seat in the bowels, by animal affections. Virtue, which is essentially one, has three distinct phases, corresponding to the threefold division of the soul. The virtue of the highest is wisdom, of the second courage, of the third temperance. The emotional part of the soul should govern the sensual, and be under the government of the intellectual. Sexual love, separated from concupiscence, he regarded as a link between the sensual and the intellectual, and as consisting in an aspiration and perpetual striving after the immortal and eternal.

Politics.—Plato's political treatises are the application of his ethical principles to social organization. In his *Republic* he does this without any regard to the practical, his object apparently being to sketch the ideal of a state which should serve as an abstract model of the things to be aimed at in social organization rather than to show how any particular object can be practically accomplished. The book of *Laws* is a sort of compromise between the speculative ideas of Plato and the actual state of society. He bases his *Republic* on the principle that the constitution of the state should correspond with that of the individual in order to allow the moral nature of the individual due scope for development. As he makes three parts of the soul, so he divides the state into three classes, the magisterial, the military, and the working, the last of which, like the sensuous part of the soul, is to be in complete subordination to the other two. The magisterial class is selected from among the middle-class, the youth of which are to be carefully trained in science and virtue. The details are worked out into a multitude of arrangements, many of which are arbitrary, tyrannical, or impracticable. All art is excluded which does not consist in the

imitation of the Good. Women receive the same education as men, and partake in their gymnastic exercises. Marriage and the intercourse of the sexes are the subject of very arbitrary and curious regulations. Of the three forms of government, monarchical, aristocratic, and democratic, he classes the first as best, the last as worst. The true king will always govern better than the law, for he will take account of particular cases and circumstances. As his knowledge of these is limited, the law is good as supplying particular principles, but it should depend ultimately on the king. Laws consecrated by custom should be considered inviolable. But space will not permit us to give any adequate account of Plato's political theories, which are a mixture of things, good, bad, and indifferent, borrowed from all the various forms of government and social organization, from theocracy to democracy, with original speculations, excellent in intention, but often arbitrary and chimerical, which have nevertheless been the fruitful source of subsequent speculations.

Plato was of an idealistic and even religious nature. He constantly rose above experience, and yearned for the realm of ideals, that world of light where 'pure forms dwell'. It is the realm of the True, the Good, and the Beautiful. A Rationalist in his theory of knowledge, maintaining that truth can only be obtained by reason and intelligence, he was a dualist in psychology and eudemonistic, or rather hedonistic, in his ethics. His doctrines exercised a considerable influence on Aristotle and the Stoics, on Cicero, and on Plutarch, and prepared the way for Neo-Platonism. The influence of Platonism made itself again felt during the Renaissance, and it may be said to be increasing to-day.

A Latin translation of Plato's works was made by Marsilius Ficinus in 1483-4, and the first edition of the text by Aldus appeared in 1513. Modern editions are those of Immanuel Bekker (1816-23) and J. Burnet (1902). Complete English translations are those of Sydenham and Taylor (1804) and Jowett (1871-92).—BIBLIOGRAPHY: Th. Gomperz, *Greek Thinkers*; G. Grote, *Plato and the other Companions of Socrates*; Walter Pater, *Plato and Platonism*; A. E. Taylor, *Plato*; J. A. Stewart, *Plato's Doctrine of Ideas*; W. Lutoslawski, *Origin and Growth of Plato's Logic*; D. G. Ritchie, *Plato*; A. Fouillée, *La Philosophie de Platon*.

Platoon, from the French *peloton*, a group or detachment of soldiers. The word was formerly in use in the British army to describe a subdivision of a company, and was then for a long period supplanted by the word section, meaning the fourth part of an infantry company consisting of 100 men. Early in 1914, when the British infantry organization was altered to provide

battalions of four large (or double) companies, the word was reintroduced to describe the main divisions of these companies. Thus 'platoon' in these days means the fourth part of a company. Each platoon is commanded by a junior officer, and has a sergeant as second in command, with the title of platoon sergeant; it is again subdivided into four sections, commanded by junior non-commissioned officers; the normal strength of a section for administrative purposes is ten, of whom no more than six will be taken into action on any given occasion. The platoon is an important link in the chain of responsibility, and the 'platoon spirit' is encouraged by every possible means. The platoon commander is responsible to his immediate superior—the company commander—for the entire training and well-being of his command, and the men of his platoon are encouraged to look to him for help and assistance, both in military and personal matters. See *Army*; *Fire-tactics*; *Infantry*.

Platte (plat), or **Nebraska**, a river of Nebraska, United States, formed by the union of the North and South Forks of the Platte, which rise in the Rockies, in the state of Colorado. The united stream falls into the Missouri after a course of about 210 miles. The North Platte has a length of 650 miles, and the South Platte 500 miles, prior to their union. All are entirely unnavigable.

Plattsburg, a city of New York, United States, the county seat of Clinton county, on Lake Champlain at the mouth of the Saranac River; served by the Delaware & Hudson Railway, and by lake-steamers. It has a harbour, and is a port of entry for the Champlain district. The town was founded in 1784, and became a city in 1902. Pop. 11,000.

Platynerium, a genus of tropical ferns, growing as epiphytes or on steep rock-faces. They have leaves of two kinds, viz., erect 'mantle' or 'bracket' leaves, which cling closely to the supporting surface and thus form humus-collecting niches, and pendulous structures, which bear the sporangia, besides performing the ordinary functions of leaves; the latter are forked and bear some resemblance to the antlers of a stag, hence the popular name stag-horn ferns. *P. alcorni* and *P. grande* are commonly grown in hot-houses.

Platyhelminia ('flat-worms'), a phylum of unsegmented flattened worms, comprising Turbellaria, Trematoda (flukes), and Cestoda (tapeworms).

Plauen, a manufacturing town and railway junction of Saxony, on the Elster. It is a great centre of the German cotton manufacture (Plauen goods), and also produces machinery, paper, leather, and all kinds of embroidered goods.

Plauen is first mentioned in history in 1122. Pop. (1919), 104,918.

Plautus, Titus Maccius, Roman comic dramatist, was born at the Umbrian village of Sarsina about 254 B.C., and died in 184 B.C. He probably came to Rome at an early age, though it is doubtful whether he ever became a full Roman citizen. He first of all obtained some kind of work in a theatre, though it is not clear whether he was a dresser, a scene-shifter, or a stage-carpenter. Whatever was the nature of his employment, it gave him a great insight into stage devices, and was of the greatest value to him when he commenced dramatist. With his earnings from the theatre Plautus went into some business, but lost all his money, and was forced to enter the service of a baker, who employed him in grinding with a hand-mill. While thus engaged he wrote three plays, the sale of which enabled him to leave the baker and devote himself to writing comedies. He was then probably about thirty years of age, and continued to write until his death at the age of seventy. In the time of Varro (116–28 B.C.) one hundred and thirty plays were attributed to Plautus. Varro went carefully into the authenticity of these plays, and decided that only twenty-one were really by Plautus. All of these twenty-one plays, except the *Vidularia*, have been preserved. The names of the extant comedies of Plautus are: *Amphitruo*, *Asinaria*, *Aulularia*, *Captivi*, *Curculio*, *Casina*, *Cistellaria*, *Epidicus*, *Bacchides*, *Mostellaria*, *Menæchmi*, *Miles Gloriosus*, *Mercator*, *Pseudolus*, *Pænulus*, *Persa*, *Rudens*, *Stichus*, *Trinummus*, and *Truculentus*. These comedies are all adaptations from Greek originals, but Plautus has adapted so skilfully that most of his plays read like original works. On closer examination, however, there appears a curious blending of Greek and Roman customs in his plays, which makes them hardly less unreal than Addison's Romans with wigs and swords. In spite of this and of their stock characters and conventional situations, almost all of the plays of Plautus are excellent, while some are superlatively good. The *Amphitruo* is a mythological burlesque of the best quality, and introduces the beautifully drawn character of Alcmena. The nemesis of the jester has overtaken some of the work of Plautus, and when he is serious he is sometimes not taken seriously by his commentators. This play has been imitated but not bettered by Molière, as has the *Aulularia*, which suggested *L'Avare* to the later and greater poet. The *Captivi* is the noblest of all the plays. Lessing, with Teutonic thoroughness, "repeatedly read it with the view of discovering some fault in it", but was obliged to confess it was perfect. The *Trinummus* is also a fine play, and the *Menæchmi* is a roaring farce, which Shake-

speare imitated in *The Comedy of Errors*. Shakespeare did not improve the play by duplicating the pairs of twins. The *Rudens* stands alone as a romantic comedy; it breathes something of the spirit of *The Tempest* or *The Winter's Tale*, and is a most attractive play. The *Bacchides*, *Mostellaria*, *Pseudolus*, and *Miles Gloriosus* are all good plays; the last-named gave to the stage one of its favourite stock characters, seen to perfection in Shakespeare's Parolles and Jonson's Bobadil. The remaining plays, with the exception of the *Stichus*, are not so interesting, and depend too much upon a series of highly complicated intrigues. Plautus enjoyed a great reputation during his lifetime, and for many years after his death. Ælius Stilo said that if the Muses wished to speak in Latin they would speak with the language of Plautus (Quintilian, x, i, 99). After the Revival of Learning, Plautus took rank as one of the greatest dramatists of antiquity. His reputation was greater than it would have been had Aristophanes been better known. His influence on comedy was immense, and is noticeable in the works of Shakespeare and Jonson, as well as in the efforts of the youngest tyro who wrote a play to be acted in his college. His influence extended throughout all Europe; it was quite as strong as the influence of Seneca upon tragedy, and was very much more wholesome. Plautus is indeed a great laughter-maker; he employs every device for amusing his audience—farical situations, caricature, repartee, caustic humour, and puns of the basest kind. In his opulence of humour, his never-failing animal spirits, and his laugh "broad as ten thousand beeves at pasture" Plautus resembles Shakespeare. In their lives they were not dissimilar. They were both wise rather than learned, both educated by life itself, not by books or universities. They both had a connection with the stage before they began to write for it. Julius Cæsar once deviated into verse and called Terence "a halved Menander". It is at least equally true to say that Plautus is a halved Shakespeare. He is that half of Shakespeare which is of the earth, earthy.—BIBLIOGRAPHY: W. Y. Sellar, *Roman Poets of the Republic*; W. M. Lindsay, *Plautus* (Oxford Texts); J. W. Duff, *Literary History of Rome*; W. L. Collins, *Plautus and Terence*.

Player-piano. Inventors gave their attention in early days to the perfecting of mechanical means of playing musical instruments, and about a century ago the Paris firm of Thibouville, Lamy et Cie produced the mechanically operated piano as a commercial article. The modern piano-player is essentially different, however, in that it is a pneumatically operated mechanism. It is interesting to note that E. H. White of Messrs. Wilcox & White of Connecticut, the inventor of both the built-in type

and also the form having the operating mechanism in a separate case, produced his first combined instrument in 1895, and the first separate-player two years later. In the early years of the twentieth century considerable progress was made in the design of pianos with internal operating gear, and this type seems now to be decidedly the more popular. The gear which is used to operate the notes is called the action. By its use the air-pressure allowed to operate through the

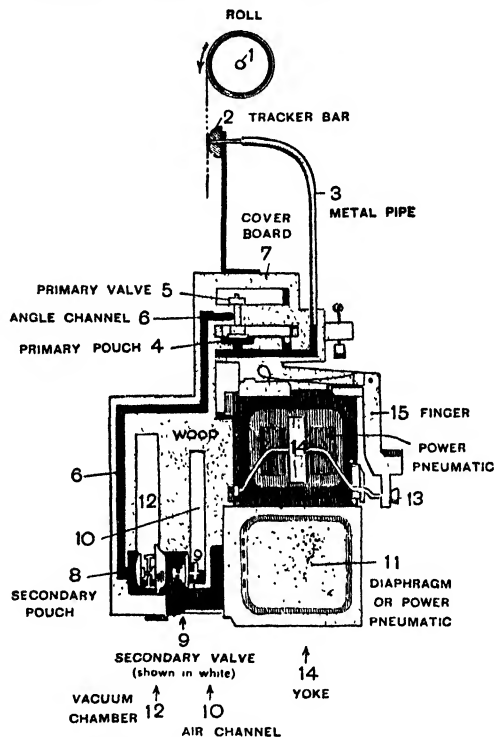


Fig. 1.—Action of Angelus Player-piano

perforations on the music-roll actuates the striking mechanism. The gear is held from striking by a vacuum created by the pedal-operated bellows. The instant the vacuum is broken the note in question is struck. The details of such an action are shown in fig. 1, which depicts the mechanism of the Angelus player-piano. The music-roll (1), perforated in positions corresponding to the notes to be struck, passes over the tracker-bar (2), which is provided with a series of holes, one for each note of the piano. A metal pipe connects each of these openings to what is termed a primary pouch (4). If there is a hole over the opening on the tracker-bar corresponding to this note, the air will pass through the pipe, and, inflating this pouch, will raise the primary valve (5). This operation

allows the atmospheric pressure, always operative under the cover-board (7), to act within the channel down to the secondary pouch (8), where a similar action to that of the primary valve takes place. This secondary valve (9), when thrust forward by the action of the air-pouch (8), cuts off the normal air which is always present in the channel (10) and the diaphragm

pedals (7) operate two bellows or exhausters (8), and thus create a partial vacuum in the reserve chest (18). The chest is connected by means of the two tubes (11) with choker-valves (12), and so to the pneumatic actions behind (10), which have been previously described in reference to fig. 1. The bass section of the piano is operated separately from the treble section,

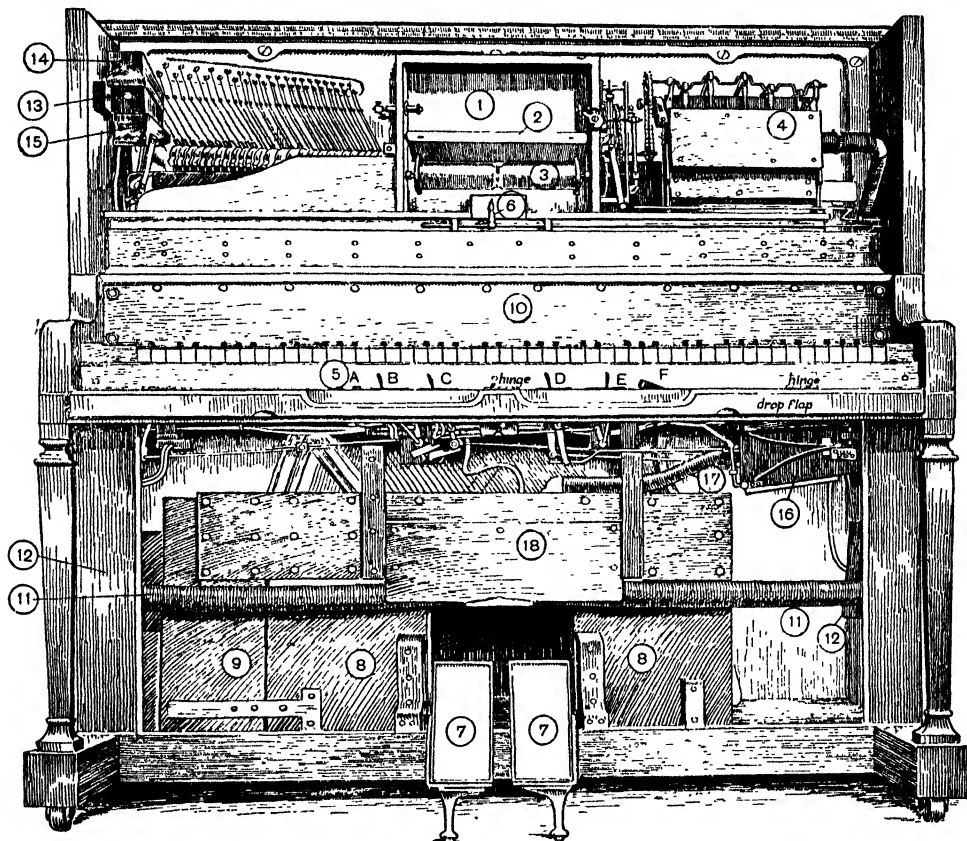


Fig. 2.—Angelus Player-piano

or power pneumatic (11), thus compelling the diaphragm to exhaust into the vacuum chamber (12). When this occurs, the diaphragm draws with it the lever or action wire (13), which passes through the yoke (14), and thus raises the finger (15), which throws up the ordinary piano-action from underneath, compelling the hammer to hit the wire. To make the diagram clear, the valves are only shown in a single row. In an actual player the valves are in two or more rows, and staggered to get them within the required space to coincide with each note of the piano. The relationship of the associated mechanisms can be seen by reference to fig. 2. The

and this necessitates the use of two choker-valves. By separating the bass and treble sections, it is made possible to soften either section independently of the other. The two buttons, one for each of the two sections, below the keyboard (5A) are used to operate valves in the chokers which act to reduce the vacuum created by the exhauster. An air-motor (4) is used to operate the roll receiving-spools through chain-drive and gearing. The air is drawn through the motor by way of a governor and tube into the main chest of the exhauster. The use of the governor ensures an even speed of the motor at all speeds of pedalling. The bellows (14 and

15) are operated through the valve-box (13). The purpose of the bellows (14) is to raise the dampers of the piano-action, and thus give a sustaining effect; it is operated by means of a tube from the tracker-bar supplied with air through perforations in the roll. The other bellows (15) acts to raise the hammers towards the strings of the piano, giving an additional softening effect when required; it is operated from the lever (5b). The next lever fitment in front of the keyboard is the re-roll lever (5c), which when placed in the re-roll position causes the winding-gear to be reversed, so that the motor rewinds the roll on its spool. By means of this lever the operator can delete any part of a composition. The tempo-lever (5d) works the pointer (6), which moves over a scale. It can be set to suit the statements of the tempo on the roll at any time. The phrasing-lever (5f) gives an instantaneous control of the tempo. A slight pressure on the left end effects a retard, a momentary hesitation in the act of striking, or a complete pause, just as the player thinks the music demands; whilst an equally slight pressure on the right end will accelerate the time to any degree required. Immediately the key is released the normal or basic time is resumed. The melodant-lever controls the operation of a device for the purpose of giving expression. By its use the solo or theme is emphasized, while the accompaniment is kept soft and subdued. The single long holes at each end of the tracker-bar are used to operate this action, and the pipes from these holes are connected to the bass and treble chokers. The sustaining-pedal lever (5e) lifts the piano-action dampers off the strings to create sustained or singing tones.

The music-rolls are marked to show the principal changes required, the pianist being expected to make the many lesser ones as his feelings prompt him. The Artistic rolls have all the changes concentrated into a single expression- and tempo-line. These rolls are edited by prominent musicians, and contain markings for all those subtle changes that make for artistic interpretation.

The most recent development in the player-piano, and one which will undoubtedly have considerable effect in the future, is the Reproducing Player-piano. This instrument, in addition to acting as the ordinary player-piano, is so constructed that when using the specially recorded music-rolls it gives a faithfully exact interpretation of the playing of the pianist who has actually recorded the roll. In the Artrio Angelus Reproducing Player-piano, an electric motor is usually incorporated, operating the exhausters by suitable connections, and so eliminating the use of the foot-pedals in the ordinary player.

We are indebted to Messrs. Sir Herbert Marshall & Sons, Ltd., of London, for information for the preparation of our description and illustrations.

Playfair, John, Scottish natural philosopher, geologist, and mathematician, born in Forfarshire 1748, died at Edinburgh 1819. Entering the University of St. Andrews at fourteen, he soon displayed a special talent for mathematics and natural philosophy. In 1785 he was chosen assistant professor of mathematics in the University of Edinburgh. In 1802 appeared his *Illustrations of the Huttonian Theory of the Earth*, and in the following year a *Biographical Account of Dr. James Hutton*. In 1805 he obtained the chair of natural philosophy in Edinburgh University. The Royal Society of London elected him a Fellow in 1807. He published *Elements of Geometry* and *Outlines of Natural Philosophy*, and contributed many valuable papers to the *Transactions* of the Royal Societies of Edinburgh and London, and to the *Edinburgh Review*. — *Playfair's Axiom*, which states that "two intersecting straight lines cannot both be parallel to a third straight line", is adopted in many modern editions of Euclid in place of the difficult twelfth axiom.

Playfair, Lyon, Baron, British scientist and politician, was born at Meerut, Bengal, in 1819, and died in 1898. He was educated at St. Andrews and Edinburgh Universities, and studied chemistry under Graham in Glasgow and London, and under Liebig at Giessen. His able reports on the sanitary condition of the large towns of Britain, and his valuable services as special commissioner at the London Exhibition of 1851, first brought him prominently before the public. He became connected with the science and art department at its establishment in 1853, inspector-general of Government museums and schools of science in 1856, and was professor of chemistry at Edinburgh University from 1858 to 1869. He held several important offices under Liberal Governments, and was created a K.C.B. in 1883, and raised to the peerage in 1892. Besides scientific memoirs, he published numerous papers on political, social, and educational subjects. Most of his economical essays were collected and published under the title *Subjects of Social Welfare*.

Pleading, in law, the statement of a case, whether embodied in a written document (statement of claim or of defence) or maintained orally in debate. A plaintiff or pursuer must put in a written statement of the alleged facts on which he bases his claim. These allegations are then admitted or denied by the defendant either categorically or with qualifications, and he also sets forth the facts which he alleges in defence. The purpose of these pro-

ceedings is to bring the points at issue clearly before the parties and the court.

Plebeians (ple-bē'anz), or **Plebs**. The whole government of ancient Rome, with the enjoyment of all its offices, belonged exclusively to the patricians, with whom the plebeians could not even intermarry. The civil history of Rome is to a great extent composed of the struggles of the plebeians to assert their claim to the place in the commonwealth to which their numbers and social importance entitled them. The struggle lasted for more than 200 years. The establishment of the tribunes (494 B.C.), the law of the twelve tables (451-450 B.C.), the Lex Canuleia (445 B.C.), permitting intermarriages, the admission to the censorship (351 B.C.), to the prætorship (336 B.C.), and to the offices of pontifex and augur (300 B.C.), were the leading steps in a succession of victories which culminated (286 B.C.) in the Lex Hortensia, which gave the *plebiscita* of the people the force of law. From this time the privileges of the two classes may be said to have been equal.

Pleb'scite (Lat. *plebs*, people, *scitum*, decree, from *scire*, to know), a term applied in the Roman Republic to the resolutions proposed by the tribunes of the people, and then adopted by the plebeians in the *comitia tributa*, i.e. assemblies by tribes. These laws were at first subject to the consent of the Senate, but after the expulsion of the decemvirs, by the laws Horatia et Valeria and Hortensia, plebiscites had at once force of law, and became binding on both plebeians and patricians. In modern Europe a plebiscite is a vote of the electors of a state expressed on a question of public importance. In France the idea of plebiscites was revived during the Revolution of 1793. It was by plebiscite that Louis Napoleon was elected Prince-President of France in 1848, and emperor in 1852. Another example was the revision of the Constitution in May, 1870. After the European War the ownership of certain districts was decided by a plebiscite, the inhabitants indicating by a direct vote the nation by whom they would prefer to be governed. Examples are afforded by the Flensborg (Slesvig-Holstein), Vilna, and Upper Silesian plebiscites. See *Referendum*, *Saar*.

Plectascineæ, a group of Ascomycetous Fungi comprising several families, in particular the Aspergillaceæ, to which belong the common green (*Aspergillus* or *Eurotium*) and blue (*Penicillium*) moulds. *Onygena* and the stag-truffles (*Elaphomyces*) also belong to this section. The distinctive feature of the group is the closed ascus-fruit (cleistocarp), in which the numerous asci are distributed irregularly among sterile hyphæ.

Plectog'nathi, a sub-order of Teleostean

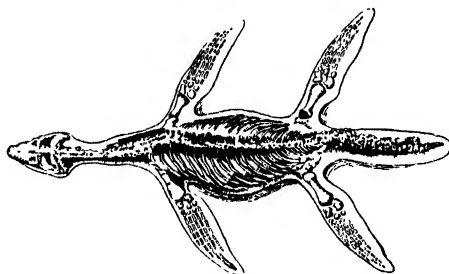
fishes, distinguished by the maxillary and intermaxillary bones on each side of the jaw being firmly united together by bony union. The head is large, and the union of its bones firmer than in any other Teleostei; the body generally short, skin horny, fins small and soft. As examples of the chief fishes included in this group may be mentioned trunk-fishes, file-fishes, globe-fishes, sun-fishes, &c.

Pleiades (plī'a-dēz), the so-called 'seven stars' in the neck of the constellation Taurus. Six stars are discernible by anyone of normal vision, and those of specially acute vision can detect a few more. Ancient Greek legends associate the Pleiades with the seven daughters of Atlas and the nymph Pleione, fabled to have been placed as stars in the sky. The fading of the seventh was variously explained. In powerful telescopes the cluster displays hundreds of stars, and photography has shown that they are all involved in a faint nebula.

Pleistocene (plis'to-sēn; Gr. *pleistos*, most, and *kainos*, recent), in geology, the highest division of the Cainozoic group, before the Recent series of deposits. The fossil remains belong almost wholly to existing species. The Pleistocene mammals include a few extinct forms. It includes the last Glacial epoch, and the deposits of this epoch have yielded the Heidelberg jaw and other traces of man.

Pleochroism, the property whereby many translucent coloured minerals appear of different tints when light is transmitted 'through them in different directions. See *Dichroic Crystals*.

Plesiosau'rus, a genus of extinct amphibious reptiles, nearly allied to Ichthyosaurus. The



Plesiosaurus

remains of this curious genus were first brought to light in the Lias of Lyme Regis in 1821, but over twenty British species are now known, and they have formed the subject of important memoirs by Owen and other palæontologists. Its neck was of great length, exceeding that of its body; it possessed a trunk and tail of the proportions of an ordinary quadruped; to these were added the paddles of a whale. The neck

vertebræ numbered twenty-four to forty-one. From twenty to twenty-five dorsal segments existed; and two sacral vertebræ and from thirty to forty caudal segments completed the spine. No distinct breast-bone was developed. The head was not more than $\frac{1}{12}$ th or $\frac{1}{15}$ th of the length of the body; the snout of a tapering form; the orbits were large and wide. The teeth were conical, slender, curved inwards, finely striated on the enamelled surface, and hollow throughout the interior. These animals appear to have lived in shallow seas and estuaries, and, in the opinion of some, they swam upon or near the surface, having the somewhat stiff neck arched, and darting it down at the fish within reach. Some of the Plesiosaurs were upwards of 20 feet long. Their remains occur from the Lias to the Upper Cretaceous rocks inclusive, the genus being thus exclusively of Mesozoic age.

Pleth'ora, a term sometimes used for the condition known as *full-blooded*, at one time supposed to be due to an excess of blood in the human system. A florid face, rose-coloured skin, swollen blood-vessels, frequent nose-bleeding, drowsiness and heavy feeling in the limbs, and a hard and full pulse are symptoms of this condition, which is habitual in many persons, and if not actually a disease, yet predisposes to inflammations, congestions, and hæmorrhages. Plethora may, however, develop in persons of all conditions and ages as the result of too much stimulating food (as an excessive meat-diet), over-eating, large consumption of malt and spirituous liquors, residence in northern and elevated regions with sharp, dry air, want of exercise, too much sleep, amputation of a limb—in short, of any action tending unduly to increase the volume of blood. Plethora of a mild form may be reduced by copious draughts of diluents, a vegetable diet, and plenty of exercise; but in cases requiring prompt relief leeches or bleeding must be resorted to.

Pleura is the serous membrane enveloping each lung. One layer of pleura adheres closely to the surface of the lung and provides it with its smooth and slippery covering, and this is called the visceral layer, while the other layer, which adheres to the inner surface of the chest-wall, is called the parietal layer. These layers, in health, are everywhere in contact, with only as much fluid between them as will ensure the lungs gliding easily in expansion and contraction. The pleura is frequently the seat of inflammation, known as pleurisy (q.v.).

Pleurisy is inflammation of the pleural membrane of the lungs (see *Pleura*), usually accompanied by some effusion of fluid, and most frequently occurring in an acute form. Probably all cases of pleural inflammation are due to

bacterial infection, but many different microbes give rise to purulent inflammation, while by far the commonest cause of simple non-purulent pleurisy is the tubercle bacillus. Along with the pleural inflammation there is an effusion of sero-fibrinous fluid of varying amount, sometimes so slight that it is absorbed immediately (*dry pleurisy*). In more severe cases the effusion is poured out more quickly and abundantly, with the result that it accumulates and a corresponding area of lung becomes collapsed, leading to the heart being displaced toward the healthy lung.

The onset is usually sudden, with shivering and a rapid rise of temperature, but it may be insidious, with indefinite pain and slight general disturbance. When the condition is established, there is general *malaise*, with loss of appetite and digestive disturbances; but the most important local symptom is pain—very sharp and severe when drawing in the breath or coughing. The pain generally subsides in three to four days, after the effusion has become abundant, and later, shortness of breath may develop as a result of the large accumulation of fluid. The patient tends to lie on the affected side in order to give the sound lung as much freedom as possible. Pleurisy is most common between the ages of twenty and forty, but may occur at any age, and it is sometimes seen as the terminal state in elderly people with Bright's disease. Adhesions of the pleura and the changes in the collapsed portion of the lung may lead to imperfect expansion of the lung for all time; but the most important result is the fact that an attack of pleurisy is presumptive evidence of tubercle, and the future development of tuberculosis of the lung must always be considered. The patient should avoid unfavourable conditions, and as much as possible lead an out-of-door life as an attempt to counteract this danger.

Pleuronec'tidæ, a family of Teleostei, including the flat-fishes, such as soles, flounders, brill, turbot, halibut, plaice, dab, &c. They swim vertically when young, but subsequently tilt over to one side; that which faces upwards (right or left) becomes dark, while that turned towards the sea-bottom (left or right) assumes a pale tint. The eye of the latter side migrates to that which faces upwards.

Pleuro-pneumonia, in cattle, lung disease which is distinguished from inflammation of the lungs and their covering membranes mainly by its greater period of latency in the system. Accidental or sporadic pleuro-pneumonia invades the chest in a few hours, or days at most, in the usual way, while the specific infectious disease may be a month or six weeks in developing definite symptoms. It is not rare for two or three months to intervene between the time of

infection and the presence of positive diagnostic symptoms.

The first sign is that of fever, increased temperature, coat standing up along the back, some shivering and tenderness, and crouching when pinched over the spine. Cough and accelerated breath follow, constipation, loss of appetite, horns and muzzle hot and cold alternately, and loss of milk in cows. The cough increases, and the symptoms generally become aggravated in the suffering beast, which separates itself from the herd in a field. Such a train of symptoms, coming at a time when infectious pleuro-pneumonia is known to be prevalent in a district or country, should be sufficient to warn the owner to seek official inspection and expert opinion as provided by the local authority at the public expense.

Plevna, or **Pleven**, a town of Bulgaria, near the River Vid, a tributary of the Danube; served by the Sofia-Varna Railway, with a line to Nikopolis (on the Danube). It is famous for the resistance of its garrison under Osman Nuri Pasha when besieged during the Russo-Turkish War (1877-8), and has also been the scene of great battles. Wine is produced in the adjacent countryside, and leather in the town, and there is a large cattle trade. Pop. 24,000.

Pleyel, Ignaz Josef, Austrian composer, born at Ruppertsthal (Austria) 1757, died at Paris 1831. He studied under Haydn, and rapidly created a reputation in Italy, France, and England. He founded a piano business at Paris, which became one of the most important in Europe, and edited the *Bibliothèque Musicale*, in which he inserted the best works of the Italian, German, and French composers. His own works, chiefly instrumental pieces, are light, pleasing, and expressive.

Plica Polonica is the name given to the mass of matted hair and crusts found in pustular dermatitis of the scalp, produced by the irritation of long-standing and neglected infection by pediculi. The name was first used about Polish Jews, among whom this condition was at one time not infrequent.

Plimsoll, Samuel, 'the sailors' friend', British politician, born at Bristol in 1824, died in 1898. He became clerk and later manager in a brewery, and in 1853 set up in business in London as a coal merchant. He began to take an active interest in the condition of sailors in the mercantile marine, agitating against the practice of putting to sea 'coffin-ships', which were unseaworthy, over-insured, and in many cases never meant to survive the journey. He entered Parliament as a Liberal for Derby in 1868, and made repeated efforts to get a Bill passed putting his views into effect. In 1873 he published *Our Seamen*. In 1876 the Merchant Shipping Act was passed, which imposed penalties on unsea-

worthy vessels, and provided for a compulsory fixed load-line (commonly known as the Plimsoll mark). In 1880 Plimsoll gave up his seat at Derby to Sir William Harcourt, and did not again enter Parliament. See *Shipping*.

Pliny the Elder, Gaius Plinius Secundus, known as 'the Elder' to distinguish him from his nephew, was born at Comum A.D. 23, and died at Stabiae A.D. 79. He came to Rome while still young, and at the age of twenty-three he went to Germany with L. Pomponius Secundus (of whom he wrote a biography in two books), and was appointed to command a troop of cavalry. With characteristic diligence he wrote *A Manual of Spear-throwing for Cavalry*. He also wrote a *History of the German Wars*. He returned to Rome in A.D. 52, studied for the Bar, and practised as a pleader for some time. About this time he wrote *Studiosus*, a work dealing with the education of an orator, and a grammatical treatise entitled *Dubius Sermo*. After being procurator in Spain, he returned to Rome in the reign of Vespasian, and wrote a continuation, in thirty-one books, of the history of Aufidius Bassus. Pliny was a most indefatigable student. He was always either reading or being read to, and he made notes of everything and had an amanuensis at hand to make excerpts. At his death he left behind 160 volumes of notes, written in very small writing on both sides of the paper. In A.D. 79 Pliny was commanding the fleet at Misenum, and was suffocated by sulphurous vapours during the celebrated eruption of Vesuvius which overwhelmed Herculaneum and Pompeii. The only work of Pliny which has been preserved is his *Natural History* in thirty-seven books. This work is a kind of encyclopedia, and deals with astronomy, geography, zoology, botany (sixteen books), and mineralogy. It is an ill-balanced and unequal work. Its geography and zoology are especially unsound. Some parts of the latter are better described as unnatural than as natural history, and some of the wonderful animals described reappear in *The Travels of Sir John Mandeville*, in the mediæval *Bestiaries*, and in some of the writings of the Euphuistic school. Pliny devoured too many books, and reproduced them in an undigested state, but we owe to him much curious information that is not preserved elsewhere.—**BIBLIOGRAPHY:** K. Jex Blake, *The Elder Pliny's Chapters on the History of Art*; J. Bostock and H. J. Riley, *Pliny's Natural History* (translation).

Pliny the Younger, Publius Cæcilius Secundus, later known as Gaius Plinius Cæcilius Secundus, nephew of Pliny the Elder, was born at Comum about A.D. 61, and died A.D. 113. His father died when he was quite young, and he was adopted by his uncle. He was elaborately educated at Rome, and was eventually called to

the Bar, where he acquired a reputation for eloquence. He inherited his uncle's fortune when seventeen years old, and seems also to have inherited some of his learning and a little of his diligence. He held in turn all the usual public appointments, being prætor in A.D. 93 and consul in A.D. 100. In the latter year he published his *Panegyric on Trajan*, a speech delivered in the emperor's presence but refurbished before publication. It is still extant, but is somewhat too fulsome in its eulogy to be quite pleasant reading. In about A.D. 111 he was sent to Bithynia as proprætor, and remained there some fifteen months. Besides the *Panegyric on Trajan*, we possess nine books of *Letters*, and one book of *Letters to Trajan*. Pliny's *Letters*, though bearing obvious signs of having been written with a view to subsequent publication, are extremely interesting, and give us a vivid picture of the life of a gentleman and a man of letters in the first century A.D. Pliny knew all the most interesting men of his day; Tacitus and Suetonius were among his friends, and Martial and Silius Italicus among his acquaintances. His relations with the Emperor Trajan were very cordial, and the collection of *Letters to Trajan*, which includes Trajan's answers, is a most valuable addition to our knowledge of Roman provincial government. Letter XCVI, and the reply to it, XCVII, provide us with a picture of the early Christians and the Roman policy towards them. Pliny was a munificent benefactor of his native town; and in a somewhat corrupt age he was a thoroughly good man, though his life was somewhat "faultily faultless, icily regular". —BIBLIOGRAPHY: J. D. Lewis, *Pliny's Letters* (translation); A. Church and W. J. Brodribb, *Pliny's Letters* (Ancient Classics for English Readers Series).

Pliocene (Gr. *pleion*, more, *kainos*, recent), the name given by Lyell to the latest system of the Tertiary or Cainozoic group of strata. Lyell's Newer Pliocene included beds, such as those covering a large area in Sicily, which contained a marine molluscan fauna almost identical with that of modern seas; in some beds only 5 per cent of the species are extinct. His Older Pliocene included the Sub-Apennine beds, with 50 per cent of molluscan species still living, and yet folded on the flanks of the Apennines, showing the recent uplift of the Italian area. The European Pliocene consists of the following stages in ascending order, Sarmatian, Pontian, Placentian, Astian, and Sicilian, and the marine beds are best studied in Northern Italy. The modern continents were gradually being evolved throughout the period, and the Lower Pliocene beds of Provence, Attica, and the Himalayan foothills have furnished remarkable evidence of the terrestrial mammalian life of the period. The

Pliocene mammals often link existing genera, and the elephant and the horse appear side by side with ancestral types. The erect 'ape-man', *Pithecanthropus*, of Java is probably of Upper Pliocene age. In Britain the Pliocene beds are poorly developed, occurring mostly in the east of the counties of Norfolk, Suffolk, and Essex. In ascending order, the series are the Coralline Crag, the Red Crag, the Norwich Crag and Chillesford Beds, and the Forest Bed of Cromer. Molluscan remains are abundant, and it is claimed that flint implements worked by man occur on some horizons. The marine



Map showing Area of Pliocene Strata in Eastern England

Lenham Beds on the chalk downs of Kent attest the earth-movements that have taken place since early Pliocene times.

Plock (plotsk), a district of Poland, traversed by the Vistula and the Narev. The area is flat, marshy, and largely afforested. Corn, potatoes, sugar-beet, and rye are the principal agricultural products. Area, 3700 sq. miles; pop. about 800,000.

Plock or **Plotzk**, a town of Poland, capital of the district of Plock, on the Vistula. There are river-steamer connections with Warsaw. Plock was formerly capital of the Principality of Masovia. There is an extensive transit trade. In Nov., 1914 (European War), Plock was taken by the Germans. The cathedral dates from the tenth century. Pop. 30,000.

Ploegsteert, a village and wood of Belgium, known to the British forces during the European War as 'Plug Street'. The village is some 8 miles south of Ypres, and about $3\frac{1}{2}$ miles north of Armentières. It was in the 'Ypres salient'.

Ploësti, a town of Roumania, capital of the department of Prahova. It fell to the Austro-German armies on 6th Dec., 1916, and is, by virtue of its position as the outlet for the valleys of the Prahova and Teleajenu, a great railway

junction and road-converging centre, and the capital of the Roumanian oil industry. Pop. (1914), 57,376.

Ploti'nus, the systematic founder of Neo-Platonism, born about A.D. 203 or 204 at Lycopolis, in Egypt, died between A.D. 262 and 270. It is conjectured that he was of Roman descent, probably a freed-man. It was in his twenty-eighth year that the desire to study philosophy awoke in him. As his first teacher, Alexandriens, gave him no satisfaction, he fell into great despondency, and was brought by a friend to Ammonius Saccas, a philosopher who was brought up a Christian and wrote some works on Christian theology, but who, according to Porphyry (controverted by Eusebius and Jerome), reverted to paganism. He remained with him till his thirty-ninth year. In 242 he joined the expedition of the Emperor Gordian to the East, in order to learn the philosophy of the Persians and Indians. After the death of Gordian he reached Antioch with great difficulty, and arrived at Rome in his fortieth year. It was here he subsequently lived and taught. About 254 his friends induced him to put his doctrines in writing. From this time till he was joined by Porphyry (about 262-264) he composed twenty-one books, which were only put into the hands of the initiated. During Porphyry's stay in Rome Plotinus composed twenty-four books, and after Porphyry had left for Sicily (267-268) nine others. On account of the weakness of his sight, Plotinus left the correction of his works to Porphyry. He was wholly indifferent to style, and exclusively occupied with the matter of his teaching; but he was accustomed to think out his ideas so thoroughly before committing them to writing that they required only literary correction. Porphyry was his literary executor, and has arranged his works in six *Enneads*. Porphyry considered those written during his own stay at Rome the most valuable, but he has not observed a chronological order in their arrangement. The works of Plotinus were highly valued by Longinus, although that philosopher was in no sense a Plotinist. Plotinus's discourse, as well as his writing, was marked by energy and enthusiasm. His teaching secured him great respect and popularity among those who did not receive Christianity. He enjoyed the favour of the Emperor Gallienus, who gave him permission to rebuild two destroyed towns in Campania, with a view to their being governed according to the laws of Plato. He retired to Campania, living in the country house of a deceased friend named Zethus, and died there.

Plotinus was one of the great masters of philosophy. The value of his system depends less upon the intrinsic truth it contains than upon its historical importance and its adapta-

tion to a certain class of human sympathies. The historical value of the system is due partly to the circumstances out of which it arose, and partly to the genius and originality of its founder. It had its source at the junction of two independent streams of thought, which, already fortuitously united, received a new direction from the individual energy of the mind of Plotinus. He was well acquainted with the older Greek philosophy, with the Ionian and the Eleatic schools, with Plato and Aristotle and other founders of systems, and, according to the eclectic tendencies of his day, he believed there was a fundamental unity in these various systems. It was to Plato, however, that Plotinus looked as his great authority. He believed himself a strict follower of Plato, and his own system a legitimate development of the principles of that great philosopher. He used Plato's term, the *Good*, for his highest generalization; but he uses it in a wholly different, and even opposite, sense from Plato. The Good with Plato was a synthesis of all that is highest and most excellent in intelligence; with Plotinus it is an abstraction from which every determinate quality is removed; and there is a corresponding difference in the ethical developments of their systems. With Plato the highest attainment of human morality is the imitation of God through the ideas discoverable by human reason, which he has placed in created things; Plotinus despises all imitations, as well as the ideal qualities which are to be imitated, and finds the practical aim of his philosophy in the direct union of the human spirit with the deity.

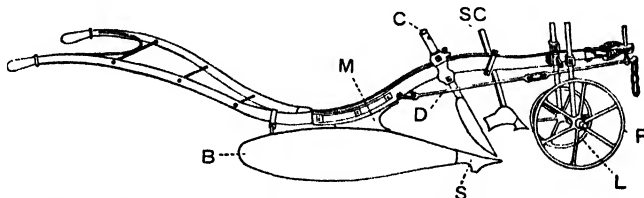
The highest generalization of Plotinus, which he calls the Good, is a pure undetermined abstraction. Out of the indetermination springs a trinity which is the source of all subsequent being. The original unity, by the excess of its energy, sends forth an image of itself, as the sun emits rays. This image, which is the beginning of plurality and the source of all determinations, also exists absolutely, and is the immediate productive power of the indeterminate unity. Turning with an involuntary movement towards its original in order to behold it, it generates spirit, which is the source of intelligence or thought. Every act of thought directed to the unconditioned produces a real existence, an idea; all these ideas differ in form, but are one in substance. The soul is developed out of the spirit as the idea contained in it; being the immediate product of the spirit, it has a share in all ideas, of which it is itself one. It has, in contradistinction to the spirit, the power of looking out from itself, and thus in imagining the world unites the sensuous with the intelligent. The sensuous is the image of the soul,

as the soul is of the spirit. Matter is the lowest boundary of being, the necessary contrast of the good, and in so far negative and evil; but in its susceptibility of form it partakes of the positive and the good. This system has the beauty of completeness, but it is entirely unsupported by evidence, and is merely evolved by the imagination of its author. It differs from that of Plato in making something anterior to intelligence, and consequently in deriving intelligence from non-intelligence; and in giving soul the power which it denies to the spirit, of looking out from itself, it makes the product superior to the producer. Yet this extraordinary system is the result of a severe system of dialectic. Plotinus believed that he followed Plato in making error and imperfection consist in multiplicity and division, and truth in simplicity and unity. Consequently the higher he could go in generalization, the nearer he approached to the source of truth, the primary form of being. Now he found that the conception of being itself was complex, and above that conception stood the conception of unity; but even to name unity was to dissolve it, hence his highest generalization was the unnameable. But the aim of Plotinus was not merely to know but to reach this undefined source of being, of which even being itself could not be predicated. To pursue truth upward to the end would necessarily lead the human mind to its source, but a source above intelligence could not be reached by intelligence; hence new methods had to be invented. Plotinus applied his dialectics to the mind and to the nature of its relation to truth, and in contradiction to the common position of psychology, that the mind can only know itself in some determinate state, he discovered that the human spirit can know itself absolutely, and to the negation of all objects of consciousness. Thinking or meditation, which is the mere act of intelligence, Plotinus held to be incompetent to reach unconditioned being, which is grasped only by intuition. Truth accordingly, he held, stands in no need of demonstration. It is comprehended immediately when the spirit sees only itself. In this pure state, to which he gave the name of *ecstasy*, the Absolute Being gazes upon itself through the medium of our spirits. Porphyry records that Plotinus had succeeded in raising himself to this state four times, while he himself had done so only once.

In virtue of this superrational method the Neo-Platonic philosophy became the system of mysticism. In default of reason it appealed to

imagination, to the love of the unknown and mysterious. With mysticism, however, came superstition, the belief in magic, and ignorant theurgical pretensions. Plotinus himself encouraged such beliefs, which allied themselves by a too natural transition with his principles. The mysticism of Plotinus has a remarkable analogy with the leading doctrines of Christianity as these are developed in the writings attributed to St. Paul and St. John. Whilst, however, Christianity affirms that man cannot by his own efforts attain to direct communion with God, but that God can be known indirectly by His works, Plotinus reverses both the affirmation and the negation. Again, both Christianity and the Neo-Platonism of Plotinus affirm the possibility of a direct communion between God and man. Christianity, however, recognizes this possibility only through the condescension of God in coming down to man, a condescension independent of human efforts, whilst Plotinus establishes this communion through the power inherent in man to rise by abstraction to God.—BIBLIOGRAPHY: A. W. Benn, *The Greek Philosophers*; E. Caird, *Evolution of Theology in the Greek Philosophers*; B. A. G. Fuller, *The Problem of Evil in Plotinus*; W. R. Inge, *The Religious Philosophy of Plotinus and some Modern Philosophies of Religion*; also article in Hastings's *Encyclopædia of Religion and Ethics*.

Plough. Since prehistoric times the plough has been the most useful and universally adopted agricultural implement. Although the early Egyptian plough merely consisted of a piece of wood to which an iron point was attached, and that of the eighteenth century was unwieldy with its wooden mould-board, whilst the modern one can be worked with much ease, the object



Diagrammatic view of Howard's Champion Plough, showing the parts
B, Breast. S, Share. M, Frame. D, Draught chain. C, Coulter. SC, Skim
coulter. F, Furrow-wheel. L, Land-wheel.

of all has been to incorporate in the soil the surface vegetation and bring up fresh soil to receive seed.

At the present time there are many different types but the wheeled single furrow is probably the most common, other forms differing only slightly in construction. Its component parts are the beam, wheels, skim coulter, coulter, frame and its fittings, and the handles.

Beam.—The beam is a strong iron bar to

which all other parts are attached. At its front end it carries the 'tee-head', a T-shaped piece of iron with a curved crosspiece, perforated to receive in any position the locking-pin of the 'hake head'. This is provided with vertical notches into which fits the draft chain for hauling the plough. The depth of ploughing is somewhat governed by raising or lowering the position of the draft chain, but the width is controlled by the position of the locking-pin in the tee-head. Sometimes the draft is taken from a rod attached to the beam in front of the mould-board.

Wheels.—Although occasionally absent, two wheels are usually fitted by means of standards to a crossbar, which is clamped to the beam behind the tee-head. The smaller one, moving on the unploughed land and regulating the depth of the ploughing by means of the variable length of its standard, is called the 'land wheel'. The larger 'furrow wheel', carried on the right of the beam, runs along the furrow, controlling the width of slice cut. In wheelless ploughs, the depth and width are controlled by the ploughman from the handles.

Skim coulter.—Situated on the beam behind the wheels and in front of the coulter is the 'skim coulter', a miniature plough, which, whilst not strictly essential, is useful for paring off surface-matted grass, weeds, and manure, which it throws into the bottom of the furrow, ensuring their rotting.

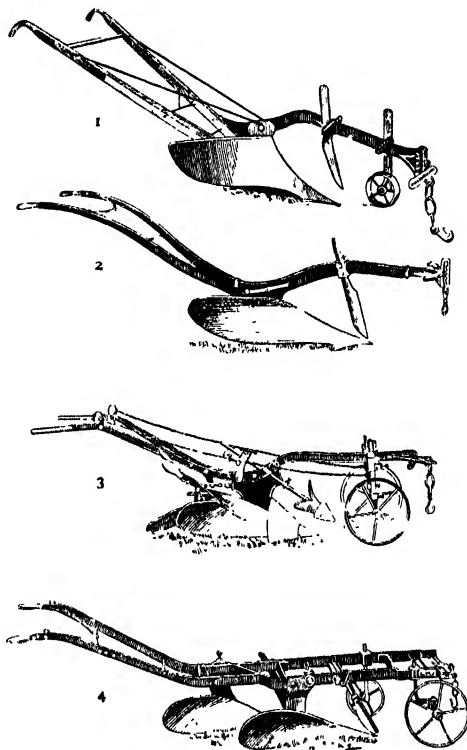
Coulter.—The coulter is passed through a socket in the beam and held in position by means of a clamp. Since its object is to make the vertical cut, it is so set that it projects forwards, making an angle of about 60° with the horizontal. It has a fairly sharp edge and pointed lower extremity which is situated about 3 inches above the point of the share. Such a coulter is sometimes replaced by a disc one on light land free from stones, where earth pushed before the ordinary one blocks the plough.

Frame.—The frame, made of cast iron, cast steel, or wrought iron, has attached to its under side a smooth flat bar, termed the 'slade', on which the plough moves easily. The share is fitted to the front end of the slade and makes the horizontal cut by means of its fairly broad sharp point and acute edge, set at about 60° to the slade. Shares of chilled cast iron keep their edge best, but they may be made of steel or ordinary cast iron. Above the slade is fitted the 'land-cap' which, pressing against the side of the unploughed land, keeps the earth from falling into the furrow. The 'mould-board' or 'breast', fitted on the right side of the frame and kept rigid by couplings and the breast stay, is made of steel, cast iron, or chilled cast iron. It is fairly long and so shaped that it causes the furrow

slice to move through a spiral curve over its convex surface, thereby inverting the cut slice.

Handles.—Handles are bolted to the beam. Held together by iron rods, they are relatively long and give the ploughman control of the implement.

Other types of plough include: (a) The *Scotch swing plough*, which has a shorter beam, longer handles, and no wheels. (b) The *digging*



1, "Oliver King" Lea Plough. 2, Howard's Swing Plough. 3, Turn-wrest Plough. 4, Howard's expanding Double-furrow Plough.

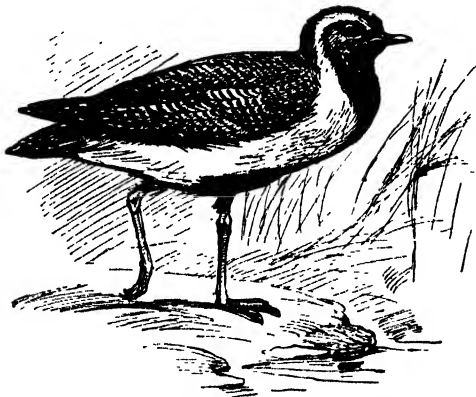
plough with a 'shin piece' forming the front of the breast and taking the place of the coulter. On account of its short concave mould-board tending to push over the earth into a fine friable state and its light draft, it is becoming very popular. (c) *Double-furrow* plough, of the digging or common type, and constructed to turn two furrows at a time. (d) *Multiple or gang* plough, popular in the colonies, and suited for turning many furrows. (e) *Tractor* plough, of two or more furrows, fitted with a special device for raising the mould-boards at the end of the furrow. (f) *Turn-wrest* plough, fitted with a reversible mould-board so that the furrows are all laid in the same direction, commonly used in

hilly land. (g) *Subsoil* plough, fitted with a device for stirring up the subsoil without bringing it to the surface. (h) *Ridging* plough, fitted with two adjustable mould-boards for making drills suitable for green crops. (i) Special purpose ploughs such as *potato raising* plough, *draining* plough, and *gripping* plough.

Ploughing is an art which requires much skill and experience. To do good work, the ploughman should be capable of directing his horses by speech with only a very occasional use of reins; he must have a properly 'set' plough with a correctly regulated draft; and, whilst keeping the plough moving along a straight path steadily, he must not bring undue pressure on the handles. If the turf is well buried, land well consolidated in straight laid furrows, finishes shallow and a good seed bed left, the soil has been well ploughed. The depth of ploughing, which averages from 5 to 8 inches, varies with the nature of the soil and crop. The breadth varies with the depth and type of plough.

Plough-Monday, in England, the first Monday after Twelfth Day. On Plough Monday the ploughmen in the northern part of England used to draw a plough from door to door, and beg money (plough money) for drink.

Plover, the common name of a number of cosmopolitan birds belonging to *Charadrius* and allied genera. They are gregarious, and most of them are partial to the muddy borders of rivers



Golden Plover (*Charadrius pluvialis*)

and marshy situations, subsisting on worms and various aquatic insects; but some of them affect dry, sandy shores. Their general features are: bill long, slender, straight, compressed; nostrils basal and longitudinal; legs long and slender, with three toes before, the outer connected to the middle one by a short web; wings middle-sized. Most of them moult twice a year, and the males and females are seldom very dissimilar in appearance. All lay their eggs on the ground, but do

not construct a nest. They run much on the soil, patting it with their feet to bring out the worms, &c. The golden plover (*Charadrius pluvialis*), also called yellow and whistling plover, is the best known. Another familiar species is the green plover, peewit, or lapwing (*Vanellus cristatus*), of which the olive-green dark-spotted eggs are considered a delicacy by epicures.

Plücker, Julius, German mathematician and physicist, was born in 1801, died 1868. He studied at Bonn, Heidelberg, Berlin, and Paris. He was appointed ordinary professor of mathematics at Halle in 1834, and at Bonn in 1836. At Halle he published *System der analytischen Geometrie*, and at Bonn *Theorie der algebraischen Curven*. He was the first to use the method of abridged notation in co-ordinate geometry. The six important equations connecting the number of singularities of various kinds in an algebraic curve are still known as Plücker's equations. In 1847 Plücker was made professor of physics at Bonn. He did some notable work in magnetism, and was the originator of the idea of spectrum analysis. In 1865 he returned to mathematics, and invented the system of line geometry. His work on this subject was left unfinished, but was completed and published by his assistant and pupil Felix Klein, afterwards professor at Göttingen, and one of the most distinguished mathematicians of the end of the nineteenth and beginning of the twentieth centuries.

Plum (*Prunus*), a genus of plants belonging to the nat. ord. Rosaceæ, sub-ord. Amygdaleæ. About a dozen species are known, all inhabiting the north temperate regions of the globe. They are small trees or shrubs, with alternate leaves and white flowers, either solitary or disposed in fascicles in the axils of the leaves. The common garden plum (*P. domestica*), introduced from Asia Minor, is the most extensively cultivated, and its fruit is one of the most familiar of the stone-fruits. The varieties are very numerous, differing in size, form, colour, and taste. Some are mostly eaten fresh, some are dried and sold as prunes, others again are preserved in sugar, alcohol, syrup, or vinegar. They make also excellent jams and jellies, and the syrup from stewed plums forms a refreshing drink for invalids, and a mild aperient for children. Perhaps the most popular of all is the greengage. A very easily grown sort is the *P. damascena* or damson. The wood of the plum tree is hard, compact, traversed with reddish veins, susceptible of a fine polish, and is frequently employed by turners and cabinet-makers. The sloe or black-thorn (*P. spinosa*) is a species of wild plum bearing a small, round, blue-black, and extremely sour fruit, which is made into sloe-gin and prune-wine, the

latter being chiefly employed by distillers, wine and spirit merchants, &c., for fining, colouring, purifying, and mellowing spirits.

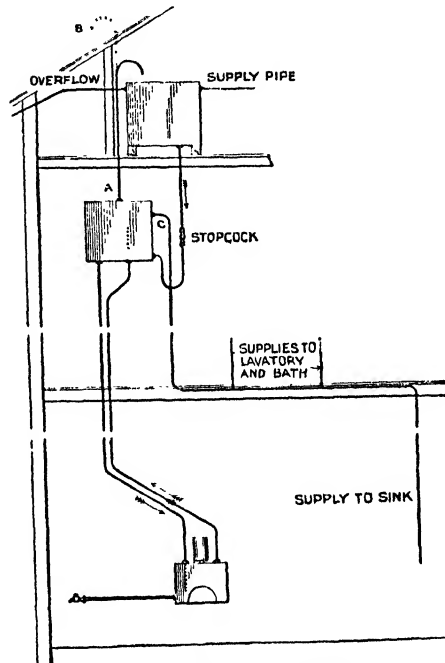
Plumbagina'ceæ, or **Plumbagin'eæ**, a natural order of gamopetalous dicotyledons, consisting of (chiefly maritime) herbs, somewhat shrubby below, with alternate leaves, and regular pentamerous, often blue or pink flowers. As garden plants nearly the whole of the order is much prized for beauty, particularly the *Staticeæ*. The common thrift or sea-pink (*Armeria maritima*), with grass-like leaves and heads of bright-pink flowers, is a familiar example. The type of this order is the genus *Plumbago*. It consists of perennial herbs or undershrubs, with pretty blue, white, or rose-coloured flowers in spikes at the ends of the branches. *P. europæa* is employed by beggars to raise ulcers upon their bodies to excite pity. Its root contains a peculiar crystallizable substance which gives to the skin a lead-grey colour, whence the plant has been called *leadwort*.

Plumbing. During more recent times the work of the plumber has changed, and instead of being merely a worker with lead, as the name implies, he has developed into a domestic engineer. His work chiefly consists of laying or fixing piping, outside or inside buildings, for distributing either hot or cold water to the various points required; of taking the cold-water supplies from street mains, or from wells, streams, or other available source; of erecting the various sanitary fixtures in buildings; of conveying waste discharges from sanitary fixtures to the drainage system; of executing drainage work, and observing that all liquid waste-discharges are effectively disposed of, either by being discharged into a sewer, or into a private sewage-purification system; of taking precautions to prevent the contamination of the water-supply after it has left the street mains, or wells, or streams; of preventing sewage gases or drain air gaining access to habitable buildings, and all enclosures where the presence of these gases would be detrimental to health; of rendering roofs watertight, and of conducting the rain-water intercepted by roofs into the drainage system; of executing gas-fitting work for either lighting, heating, cooking, or for power purposes; and of erecting centralized systems for the warming of buildings.

Cold-water Supply.—When water is obtained from a Local Authority or Water Board it is supplied on either the 'constant' or intermittent principle. More commonly the supply is constant, and this minimizes the risks of pollution, as the water is fresh and there is no need to store it in cisterns. In high-lying districts an intermittent, or partially intermittent, supply

of water may be the only one obtainable. Under these conditions cisterns require to be fixed at high levels in buildings, in order that water may be stored ready for use. In these cases water is more liable to pollution, owing to dirt or foreign matter gaining access to the cisterns, or a storage receptacle itself may be the cause of water pollution.

Domestic Hot-water Supplies.—Water for domestic purposes may be heated by a boiler



Hot-water Supply by Tank System

A, Air and steam escape pipe from hot-water tank. The end of the pipe may either terminate over the cold-supply system or be carried through the roof and bent over as at B.
C, Draw-off pipe for hot-water tank.

behind a fire, either in a sitting-room or in a kitchen range. A gas-heater may take the place of a coal fire, or an independent class of boiler may be used. The principle is the same in either case, and a complete system consists of a heater or boiler, hot-water storage-tank, circulating pipes between the boiler and hot-water storage-tank, an overhead cold-water supply-cistern, and piping for the distribution of the hot water. At the outset the heat from the fire is conducted through the metal of which the boiler is made, and the water inside the boiler has its temperature raised by coming into contact with the heated surfaces. The water in the hot storage-tank is heated by convection, owing to

its circulating between the boiler and the tank. The outflow of water through any draw-off tap is directly due to the water-pressure in the overhead cistern, and the outflow is not influenced by the temperature of the water itself.

Drainage Work.—Drain pipes may be either of iron or of earthenware, the former material being the more suitable where drains require to be laid through buildings, or where work of a high-class character is required. The principal points requiring attention are: drains should be laid in straight lines on firm beds between changes of direction, be suitably jointed, made readily accessible, be well ventilated throughout their entire length, be laid with gradients that yield a self-cleansing velocity, be as simple and short as practicable, whilst all gully traps should be avoided that are not absolutely necessary.

Soil, Waste, and Rain-water Pipes.—The pipes for carrying off the waste matter from sanitary fixtures, and those for conducting the rain-water from roofs, are usually of cast iron. Soil pipes are sometimes made of lead, but this material is unsuitable for long waste pipes through which hot and cold water alternately flow. The usual method is to discharge the waste matter from water-closets through pipes quite distinct from those that convey the waste water from sinks, baths, and lavatories. There is, however, a movement to simplify the present practice, and to make use of fewer pipes. The details of construction of all sanitary work are regulated by by-laws that are put into operation by Local Authorities through sanitary inspectors, health officers, or other officials.

Sanitary Fixtures.—The features that should be incorporated in all these fixtures are simplicity of construction and cleanliness. For general buildings water-closets take two principal forms, the 'wash-down' and 'siphonic' types. In the former the pans are cleansed by the force and body of flushing water that carry the waste matter forward and through the trap. In the siphonic form the contents of the basin are removed by siphonage, instead of depending upon the impact of the flushing water. Lavatories, baths, and sinks should be provided with large accessible overflows and waste outlets, and be free from inaccessible parts in which filth may accumulate.

External Roof Work.—In order to render roofs watertight where two or more intersect, or where chimneys or other forms of construction pass through them, or where the roof comes in contact with walls, or where large flat surfaces interpose, lead work is usually carried out. Sheet lead has the advantages that it can be simply worked into various shapes and readily applied. Lead work is also durable, and can be executed at reasonable cost. Sheet copper or

zinc is occasionally substituted for lead where a lighter material is desirable or necessary. Copper is a very serviceable material but more costly to apply, whilst zinc is unsuitable in towns and manufacturing districts on account of its tendency to corrode. Zinc may, however, be used in country districts where sulphurous fumes are absent.

Lead Burning is a method of jointing lead work. It is displacing soldering in many cases, owing to its lower cost. A blow-pipe is used for lead burning, and the gases employed are usually hydrogen and atmospheric air, or coal-gas and oxygen. Each combination of gases, when ignited and in the right proportions, produces a hot clean flame. There are different ways in which burnt joints are made, but, speaking briefly, they are formed either by overlapping the edges of the lead and fusing the one into the other by the blow-pipe flame, or by fusing the edges to be joined with an additional body of material that is supplied by a thin bar or strip of lead, as the joint is being made.

Plume-bird, the *Epimachus magnus*, or long-tailed bird of paradise, with plumage showing the most brilliant hues of scarlet, emerald, violet, and ultramarine. It is a native of New Guinea.

Plume-moths (Pterophoridae), a small family of moths remarkable for having their wings split up into a number of plumes, usually the forewings into two and the hind-wings into three. The white plume-moth (*Pterophorus pentadactylus*) is a pretty insect with snowy white wings, and is common in gardens.

Plumer, Herbert Charles Onslow, first Baron, British soldier, was born 13th March, 1857, and joined the Royal Army (Yorkshire and Lancashire Regiment) in 1876. He served in the Sudan (1884), commanded a mounted force during the Matabele Rising in South Africa (1896), and raised the Rhodesia Field Force which he commanded during the South African War (1899–1902). During the latter campaign he was made a C.B. and aide-de-camp to the queen, and at its close he became major-general. Until the outbreak of the European War he successively held the posts of brigade-commander (1902–4), quartermaster-general (1905), Fifth Divisional commander (1905), and Commander-in-Chief, Northern Command (1911–4). He was knighted in 1906, and promoted lieutenant-general in 1908.

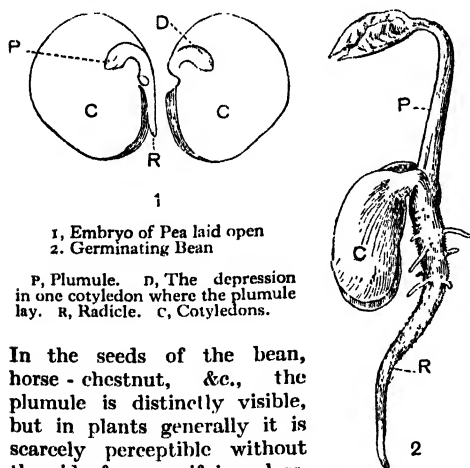
In May, 1915, General Plumer was appointed to command the Second Army on the Western front (European War), and was practically inactive during the years 1915 and 1916. On 7th June, 1917, he gained a decisive victory at Messines, and was subsequently employed in consolidating the Allied positions in the Ypres

salient. After the Italian disaster at Caporetto, Plumer was dispatched with Allied reinforcements to the basin of the Po (Nov., 1917), but was urgently recalled in March, 1918, to command the Second Army prior to the great German offensive. During the British advance which commenced in Aug., 1918, General Plumer was distinguished for his strategy, foresight, and complete command of affairs, and was largely instrumental in ridding Belgian Flanders of the obstinate and desperate Hun. In 1919 he was made Field-Marshal and was raised to the peerage as Baron Plumer of Messines and Bilton, receiving also a grant of £30,000. After commanding the Army of Occupation on the Rhine, he was appointed Governor and Commander-in-Chief of Malta, where he took up office in June, 1919.

Plumstead, a district of London forming part of the metropolitan borough of Woolwich. It is in Kent, $11\frac{1}{2}$ miles from Charing Cross, and is served by the South-Eastern & Chatham Railway, and by tramways and omnibuses. Pop. 72,000.

King Edgar gave Plumstead Manor to the Augustinian foundation at Canterbury (A.D. 960), and it passed in the eighteenth century to Queen's College, Oxford. Plumstead Marshes (2000 acres) were walled in by the monks of the twelfth-century Augustinian foundation, Lesnes Abbey, but were submerged between 1527 and 1563, when the work of reclamation was begun.

Plu'mule, in botany, that part of the seed which grows into the shoot of the future plant.



1. Embryo of Pea laid open
2. Germinating Bean

P, Plumule. D, The depression in one cotyledon where the plumule lay. R, Radicle. C, Cotyledons.

In the seeds of the bean, horse-chestnut, &c., the plumule is distinctly visible, but in plants generally it is scarcely perceptible without the aid of a magnifying glass, and in many it does not appear till the seed begins to germinate.

Pluralism, in metaphysics, is the doctrine which maintains that being and reality can be reduced to a multiplicity of relatively independent, single elements. It is thus the antithesis of singularism (monism), which teaches

that multiplicity is appearance and not reality. Pluralists are: Democritus, Leibnitz, Lotze, Haeckel, and others. Some of the pluralists taught a materialistic pluralism (atomic theory), others a spiritualistic pluralism (monads). None of these pluralists, however, denied the absolute unity of the universe. Modern pluralism, on the contrary, denies the fundamental completeness of the universe, and conceives reality as in a state of becoming. The unity of the universe is not to be sought in the past and retrospectively, but in the future and its possibilities. The new pluralism has been championed in recent times by W. James. See *Pragmatism*.

Plurality, in ecclesiastical law, signifies the holding by the same person of two or more benefices. Pluralities were forbidden by the canon law, but the bishops and the Pope assumed the right of granting dispensations to hold them. They were prohibited by the Councils of Chalcedon (451), Nicæa (787), and Lateran (1215). In England pluralities in the Church are forbidden excepting in particular cases, such as where two livings are within 3 miles of each other, and the value and population small.

Plush, a fabric similar to velvet, from which it differs only in having a longer and denser pile. The pile is formed from cotton, silk, or other warp yarns; thus imitation sealskins have a pile which when dyed resembles the real article. During the operation of weaving, wires are inserted under the warp yarns, and the upper bends of the loops thus formed are cut by a knife edge on the end of the wire as the latter is withdrawn mechanically. The pile threads are naturally bound securely to the foundation of the fabric, in the formation of which yarns spun from other fibres are used. Several wires are used, and they are drawn out one by one. Two fabrics are often woven face to face, and the pile threads which bridge the gap between the two cloths are cut in the loom as the two cloths are being woven, or else cut after the fabrics leave the loom. This method of weaving is termed 'double-plush' weaving, and its chief advantage is that no wires are required for the operation. In some looms for double-plush weaving, however, another advantage obtains in that two shuttles are sent across simultaneously, one for each cloth. Such cloth is manufactured in several countries, e.g. Great Britain, America, France, Germany, and the products used for curtains, upholstery, and the like.

Plutarch, Greek biographer and miscellaneous writer, was born about A.D. 46, and died about A.D. 120. His native town was Chæronea, in Bœotia, where he spent much of his life and where he died. He was educated at Athens, and spent some years at Rome, where he lec-

tured on philosophy and (according to a mediæval authority) acted as tutor to the future Emperor Hadrian. This is almost all that is known about the life of Plutarch. Plutarch's reputation rests upon his *Parallel Lives*, a collection of forty-six biographies arranged in pairs, each pair consisting of a Greek and a Roman whose careers or characters were more or less alike. This book had an influence upon the Revival of Learning greater, perhaps, than that of any other book, and it did more to interpret ancient Greece and Rome to modern Europe than many works of greater creative genius. Plutarch did not intend to write history but biography; he rightly argued that a man's character was shown not so much by his behaviour in the crises of his life as by his ordinary conversation, and by his jests and apophthegms. His biographies, accordingly, are admirable specimens of portrait-drawing; though he has done much research and consulted many authorities, his work is alive, not "made tongue-tied by authorities". Plutarch is one of the few authors who lose little by being read in a translation. Amyot's famous translation into French is more accurate but hardly less renowned than the English version of it by Sir Thomas North. Shakespeare used North's translation when writing *Julius Cæsar*, *Coriolanus*, and *Antony and Cleopatra*. Plutarch's other writings, above sixty in number, are grouped under the general title of *Moralia*. These works vary greatly in value, some of them being highly entertaining, some preserving important information, and some being devoid of interest. A few of the last class at any rate are not genuine. These treatises deal with such subjects as *The Cessation of Oracles*, *The Education of Children*, and *The Ill-nature of Herodotus*.—BIBLIOGRAPHY: R. C. Trench, *A Popular Introduction to Plutarch*; J. Oakesmith, *The Religion of Plutarch as expounded in his Ethics*; Sir J. P. Mahaffy, *Silver Age of the Greek World*.

Pluto, in classical mythology, the god of the infernal regions, the ruler of the dead. He was a son of Cronus and Rhea, a brother of Zeus (Jupiter) and Poseidon (Neptune), and to him, on the partition of the world, fell the kingdom of the shades. He married Persephônê. By the Greeks he was generally called Hades, and by the Romans Orcus, Tartarus, and Dis Pater. The worship of Pluto was extensively spread among the Greeks and Romans. The cypress, the box, the narcissus, and the plant *adiantum* (maiden-hair) were sacred to him; oxen and goats were sacrificed to him in the shades of night, and his priests were crowned with cypress. He is represented in gloomy majesty, his forehead shaded by his hair, and with a thick beard. In his hand he holds a two-

forked sceptre, a staff, or a key; by his side is Cerberus.

Plutonic Rocks, crystalline rocks, such as granites, greenstones, and others, of igneous origin, which have consolidated at great depths below the surface of the earth. They are distinguished from those called volcanic rocks, although both series are igneous, the volcanic rocks having solidified at or near the surface.

Plutus, in Greek mythology, the god of riches, to be distinguished from Pluto (q.v.). Zeus struck him blind because he confined his gifts to the good; and he thenceforth conferred them equally on the good and the bad. His residence was under the earth. Plutus is the subject of the last, the most freely annotated, and the least amusing of the eleven extant comedies of Aristophanes.

Pluviose, the month of rain, the fifth month of the French Republican calendar, beginning on 20th, 21st, or 22nd Jan., and ending 19th, 20th, or 21st Feb.

Plymouth (plim'uth), a seaport, municipal, parliamentary, and county borough of England, in Devonshire, at the head of Plymouth Sound, between the estuaries of the Plym and Tamar; served by the London & South-Western and Great Western Railways. Taken in its largest sense, Plymouth comprehends what are called the 'Three Towns', or Devonport on the west, Stonehouse in the centre, and Plymouth proper on the east. Plymouth proper covers an area of about 1 sq. mile, the site being uneven and somewhat rugged, consisting of a central hollow and two considerable eminences, one on the north, forming the suburbs, and the other, called the Hoe, on the south, laid out as a promenade and recreation ground. The old Eddystone Lighthouse has been re-erected in Hoe Park, which also contains a statue of Sir Francis Drake by Boehm. The top of the Hoe offers magnificent land and sea views. The guild-hall, a Gothic building, is the finest modern edifice (1870-4), and has a tower nearly 200 feet high; among other buildings are St. Andrew's Church and the Athenæum. The citadel, an obsolete fortification built by Charles II, is another object of interest. The manufactures are not very extensive, and chiefly connected with ships' stores for the naval depôt at Devonport; but the fisheries are valuable, and Plymouth has a large export and coasting trade. Its chief importance lies in its position as a naval station. Thanks to extensive and sheltered harbours, Plymouth rose from a mere fishing-village to the rank of foremost port of England under Elizabeth, and is now as a naval port second only to Portsmouth. The Western Harbour, or the Hamoaze (mouth of the Tamar), is specially devoted to the Royal Navy, and here (in Devon-

port, q.v.) are the dockyard, and Keyham steam-yard; the victualling yard, marine barracks, and naval hospital being in Stonehouse. The harbour accommodation of Plymouth proper consists of Sutton Pool and the Great Western Railway Docks in Mill Bay, with the Catwater, or estuary of the Plym. It is supplied with water from Dartmoor by a *leat* or channel constructed by Sir Francis Drake. Subsequent to the European War, Plymouth 'adopted' the town of Estaires. Pop. (1921), 209,857.

Plymouth, a town of Massachusetts, United States, the county seat of Plymouth county, on the Plymouth Harbour arm of Cape Cod Bay; served by the New York, New Haven, & Hartford Railway, by electric-traction lines, and by steamers (in season) to Boston. There are many interesting landmarks and curiosities. Plymouth was the scene of the landing of the Pilgrim Fathers in 1620, and the exact spot is marked by a granite boulder known as Plymouth Rock. Pop. 14,000.

Plymouth, the capital of the Island of Montserrat (q.v.), Leeward Islands, West Indies. Pop. (1921), 1709.

Plymouth Brethren, a Protestant sect which first appeared at Plymouth in 1830, and has since considerably extended over Great Britain, the United States, and among the Protestants of France, Switzerland, and Italy. They object to national Churches as being too lax, and to dissenting Churches as too sectarian, recognizing all as brethren who believe in Christ and the Holy Spirit as his Vicar. They acknowledge no form of Church government nor any office of the ministry, all males being regarded by them as equally entitled to 'prophesy' or preach. At first they were also called Darbyites, after John Nelson Darby, originally a barrister, subsequently a clergyman of the Church of England, to whose efforts their origin and the diffusion of their principles are mainly to be ascribed. They entertain millenarian hopes, baptize adults, and administer the sacrament, which each takes for himself, each Sunday. At their meetings a pause of unbroken silence ensues when no one is moved to speak. They hold both civil governments and ecclesiastical organizations to be under divine reprobation, the former as atheistic, the latter as in a state of apostasy.

Plymouth Rock Fowl. See *Poultry*.

Plymouth Sound, an arm of the sea, on the south-west coast of England, between the counties of Devon and Cornwall. It is about 3 miles wide at its entrance, bounded by elevated land, which descends abruptly to the sea. It contains Drake Island, which is fortified, and is protected by the Plymouth Breakwater, 1 mile long.

Pneumatic Dispatch, a system of transmitting papers, money, and other small articles

in hollow carriers forced or drawn through tubes. This is the method used by the British post office for the conveyance of telegraph forms from the post offices in the central districts of large towns to the general post offices. The 'carriers' are forced or drawn through tubes passing underground. Compressed air, usually at 10 lb. per square inch, or a vacuum of generally $6\frac{1}{2}$ lb. per square inch provides the propelling force. The tubes in this case are made of lead and 3, $2\frac{1}{2}$, or $1\frac{1}{2}$ inches diameter, the medium size being generally used. When manufactured, the tubes are in 28-foot lengths, and are laid in wooden troughs for protection during handling. Every care is taken to ensure that the tubes are circular, of uniform diameter, and smooth. The tubes are joined up in position, the joint being made while a steel mandril occupies the tubes at the butted ends to ensure smoothness and correct diameter. Iron pipes are passed over the lead ones for protection before the earth is replaced and the road made up. The carriers are cylindrical tubes of gutta-percha covered with felt, and a little over 6 inches long. A 'skirt' projects beyond the open end of the carrier, and is useful in preventing leaks. The speed of the carrier is roughly stated as from 20 to 30 miles an hour in tubes not exceeding 1 mile in length.

The tubes used in installations inside offices and warehouses are generally made of brass or copper. The circuit in this case is provided with loop connections to the various departments.

Pneumatic Power Transmission. Compressed air is a very serviceable and effective medium for the transmission of power. In large engineering works and shipbuilding yards it is customary to have a central air-compressor station from which pipes convey compressed air to pneumatic tools of all characters. In the installation at the Armstrong Naval Shipbuilding Yard at High Walker on Tyne there are eight electric-driven air-compressors, capable of raising the pressure of a total of 13,000 cubic feet of free air per minute to 100 lb. per square inch. The total horse-power is 2500. The compressed air is stored in a cylindrical steel tank 30 feet high and 8 feet diameter. From the store the air is conveyed through mains, 14 inches diameter, to the various sections of the works, and smaller pipes within the departments are tapped at various points to provide air-supply for the tools.

Air-compressors of this character have a form somewhat resembling that of a steam-engine, but their internal construction is different in many respects. The cycle is commonly performed on both sides of the piston, but sometimes the cylinder to one side of the piston is used for the first stage in the compression, and to the

other side for the high-pressure operations. As air is compressed some part of the energy expended is used in raising the temperature. This loss is reduced by the use of an efficient cooling system, comprising water-jackets and injection-jets. When two-stage compression is used, the air is passed from the low-pressure cylinder to an intercooler, where its temperature is reduced before it passes into the high-pressure cylinder. These intercoolers consist of simple cast-iron vessels, through which the air is made to take a circuitous path between tubes or metal faces kept cool by running water.

Small portable air-compressors driven by petrol- or paraffin-engines have been introduced into engineering. Pneumatic hammers, chipping-tools, and grinding-machines are very useful in welding work where repairs have to be made without removing the parts of the broken structure to an engineering works. In such cases they receive their air-supply from these small units.

In Britain it is common for public authorities or limited companies to supply electricity, gas, and water under pressure to power users, but the supply of compressed air for some reason or another has received little, if any, attention. Compressed air provides a means of economical power transmission which has many advantages. In Paris compressed air is supplied by a public company from two central stations through many miles of piping, the most distant point of delivery being about 5 miles from the station. Small tradesmen use air-motors, frequently old steam-engines, to drive their machines. The air-supply is usually passed through pipes placed in the stove, so that a certain amount of pre-heating can be obtained. The actual amount of work obtained from each pound of air used is proportional to the absolute temperature of the air at entry.

An attempt was made in 1887 to prevent the formation of ice and snow in the ports of an air-motor by the simple expedient of pre-heating the air, and it is said that it was during these tests that the great gain in economy produced was first noticed. A system of power transmission which permits the consumer to increase the efficiency of his power plant by using a small amount of the waste heat from his stove has much to recommend it. Compressed air is used to a large extent in coal-mines for the operation of coal-cutters. Other uses are referred to in the article *Compressed Air*.

Pneumatics, that branch of physics which treats of the mechanical properties of elastic fluids, and particularly of atmospheric air. The chemical properties of elastic fluids (air and gases) belong to chemistry. Pneumatics treats of the weight, pressure, equilibrium, elasticity,

density, condensation, rarefaction, resistance, motion, &c., of air; it treats also of air considered as the medium of sound (acoustics), and as the vehicle of heat, moisture, &c. It also includes the description of those machines which depend chiefly for their action on the pressure and elasticity of air, as the various kinds of pumps, artificial fountains, &c. The weight of the air, and its pressure on all bodies on the earth's surface, were quite unknown to the ancients. Their discovery is due to Torricelli, who gave the correct explanation of the failure of a suction-pump to raise water beyond a certain height, a fact which had been observed by Galilei. See *Aeronautics*; *Air-pump*; *Atmosphere*; *Barometer*; *Diving-bell*; *Gases, Properties of*; *Hydrostatics*; *Manometer*; *Pumps*.

Pneumonia. Several diseases are caused by the germ known as the *pneumococcus*, of which lobar and lobular pneumonia are the most important.

Lobar pneumonia is an acute infection characterized by inflammation of the lungs, with severe toxæmia and fever, and usually ending by crisis. The disease was known to Hippocrates and the old Greek physicians, and since then has apparently been well known to each successive generation of medical practitioners. It is one of the most widespread and fatal of all acute diseases, and is world-wide in its distribution. It is common in Great Britain, and even more common in the United States of America. It attacks all ages, but in young children the pneumonia is much more likely to be of the lobular type (broncho-pneumonia), while lobar pneumonia is found frequently in adolescence, young adults, middle life, and the elderly.

Males are more frequently affected than females, because of their greater liability to exposure to cold and hardship, which are, along with alcoholism, the most prominent predisposing causes. Any debilitating cause, however, renders a person more susceptible, and in no other acute disease are recurrences so frequent. Climate does not appear to have much influence, as it prevails equally in hot and cold countries, but the dry, overheated air of the houses in America, with the contrasting cold out of doors, favours catarrhal infections in the air-passages, and explains in part the high incidence of the disease there. Almost all the statistics show that the disease is most frequent in the late winter and early spring months. In considering the conditions that favour infection, it has to be remembered that the majority of people harbour the germ of pneumonia in the mouth or nose or throat, and that the virulence of the germ varies at different periods. It thus becomes a contest

between the degree of resistance and the virulence of the germ, and such factors as catarrh of the upper air-passages, exposure to cold, alcoholism, &c., lower the resistance and give the germ, till then held in check, a chance to establish itself and produce the acute infection.

Probably the incubation period is very short, and, as a rule, the disease starts abruptly with a severe, well-marked chill. This may be so sudden that a rigor sets in when a person is at work or going about. There is a rapid rise of temperature, with headache and general pains, and in a short time there follows definite and very severe pain in the affected side of the chest. After two or three days the typical pneumonia picture is seen. The patient lies flat in bed, usually on the affected side, with flushed face and giving short rapid breaths, accompanied by an expiratory grunt. The alæ of the nose dilate with each breath; the eyes are bright, often with unequal pupils; herpes appear on the lips. The patient has an anxious expression, giving frequent short coughs which cause marked pain, and there is a tough, blood-stained spit. This state continues, or may become worse, and death occurs, either from early heart failure, or more frequently from the action of the poison on the vasomotor centres, causing a progressive lowering of the blood-pressure.

On the other hand, after about a week the crisis may take place and the patient recover. The crisis, which may appear as early as the third day and as late as the twelfth, is usually seen about the seventh day, and with it there is a very rapid fall of temperature, with a marked abatement of the symptoms. Usually there is abundant perspiration, and the patient falls into a comfortable sleep. There is always a certain degree of pleurisy (q.v.) present whenever the inflammation reaches the pleural membrane, and this is the cause of the very severe local pain. The most common complications are pericarditis, endocarditis, and meningitis. Relapses are rare, but recurrences after a period of time are common, and a person may have several attacks of pneumonia. Convalescence is rapid, and it is uncommon to have sequelæ. The mortality varies according to the age of the patient. Between the ages of twenty and thirty it is about 20 per cent, between thirty and forty about 30 per cent, after that with each decade it rises till above the age of sixty over one-half of those attacked die.

Lobular pneumonia, or broncho-pneumonia, is an acute infection of the smaller air-passages and the related lobules. The disease may be either primary, and set in without any previous bronchitis, or it may be secondary to bronchitis in measles, whooping-cough, diphtheria, influ-

enza, scarlet fever, and other infectious diseases. The primary form usually attacks children under two years, while the secondary type, more frequently seen, follows the infectious diseases, and causes more deaths than are due directly to the fevers themselves. Secondary broncho-pneumonia may further arise when some foreign body gets into the smaller bronchial tubes, and occurs in cases of loss of sensation of the larynx, as in coma, after operations about the mouth or nose, in tracheotomy, and in cancer of the larynx. It is known as aspiration pneumonia.

Most cases of broncho-pneumonia are in children under five years, and it has been found that rickets and diarrhoea are marked predisposing causes. It is widespread, but prevails most extensively among the poorer classes. The primary form sets in abruptly, and runs a somewhat similar course to lobar pneumonia, but does not terminate with such a definite crisis, while the secondary form does not terminate by crisis at all, but by a gradual fall of temperature, called lysis. It begins as a bronchitis, and usually follows measles or one of the infectious diseases, when, after a diminution of the original fever symptoms, there is an accession of fever with cough, rapid breathing, and increased pulse, and the child becomes very ill.

The primary form is not nearly so serious or fatal, as when in its secondary form. broncho-pneumonia attacks a child already weakened and debilitated by some other disease.

The death-rate in children is between 30 and 40 per cent, and it has been observed that thin, wiry children stand the attack better than the fat, flabby ones.

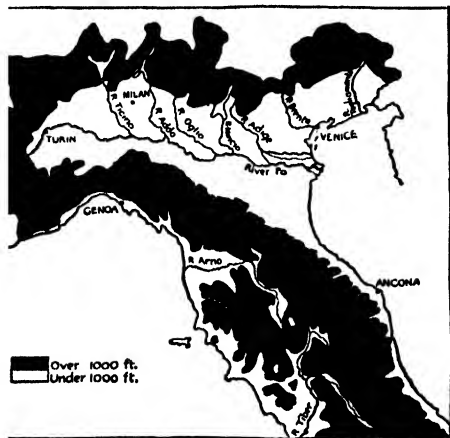
Aspiration pneumonia, which usually occurs in adults, is a very fatal disease. Care of a child during measles, whooping-cough, and similar diseases can do much to prevent the onset of broncho-pneumonia, and for this purpose the most important measures are avoidance of chill and attention to catarrh of the nose and throat.

In all forms of pneumonia careful nursing and constant watch over the patient's condition are essential, and many cases which are dangerously ill for several days may be brought over the critical period by these steps.

Pnôm-penh, the capital of Cambodia, French Indo-China. It lies at the head of ocean-going navigation on the Mekong River, and has good quays and embankments. There is a large trade, and there is a cotton-ginning mill at Khsach-Kandal, an adjacent hamlet. Cattle-breeding is a native industry in the district between Pnôm-penh and Manila. Good roads lead from the town (1) to the Gulf of Siam, and (2) to the district south-west of the lakes. Pnôm-penh has been almost entirely rebuilt by the French, and is traversed by boulevards. The principal build-

s are of an ecclesiastical nature, and include : palaces of the Buddhist priests and the goda. Pop. 87,870.

Po (ancient Padus or Eridānus), the largest er of Italy. It rises on the confines of France i Piedmont in Monte Viso, one of the Cottian os, and flows through Piedmont, Lombardy, i Venetia to the Adriatic (about 450 miles). divides the great plain of Lombardy into o nearly equal parts, receives many streams ving south from the Alps, and others that v north from a part of the Apennine range, l serves as an inland water-way for over three-rters of its course. The total catchment area bout 28,000 sq. miles. Its principal affluents



Map of Northern Italy showing the Po Basin

: on the left, the Baltica, Sesia, Ticino, Adda, l Mincio; on the right, the Tanaro, Trebbia, l Panaro. The Po, in spite of embankments, , is the cause of frequent inundations, espe- ly near its mouth. The Adriatic Sea is a ndered area like the western basin of the iterranean, and it has probably sunk in es so geologically recent that the ancestors he jackals, that lived till lately on the Island acman, off Dalmatia, may have walked there rland. The basin of the Po (or Plain of Lom- dy) occupies a depression (part of the found- ed area) between the Alps and the Northern nnines, and is a landward continuation of depression, the lower part of which is occupied the Adriatic.

oa, a large genus of grasses, natives of perate countries. Many are useful pasture sses, e.g. *P. pratensis* (smooth-stalked meadow- ss) and *P. trivialis* (rough-stalked meadow- ss); *P. nemoralis* is valuable for lawns. *P. uia* is one of the commonest of weeds.

oaching, in English law, a term applied

to the act of unlawfully trespassing on another's property for the purpose of stealing or killing game, or of catching fish. For the law relating to game, see *Game Laws*. In England, when a person's land adjoins a stream where there is no ebb and flow, that person is assumed to have an exclusive right to fish in the stream as far as his land extends, and up to the middle of the stream; and so also when a person's land encloses a pond, the fish in that pond belong to him. Where several properties are contiguous to the same lake, the right of fishing belongs to the proprietors, in proportion to the value of their respective titles. Generally the public have the right of fishing in a public river, that is, one in which there is ebb and flow; but an exclusive right is held by some proprietors by virtue of royal franchises or otherwise. Persons who in the daytime angle for fish in waters where they have no right or leave are liable to have their tackle seized by the owner of the land or fishery, or his servant, and if they submit they are liable to no other penalty. The owner or his servant may deprive the angler of his fishing-gear. Angling by night in private waters entails a penalty of £2, and if done in water adjoining or belonging to a dwelling-house, of £5. Any person, not an angler, found fish-poaching on private property is liable to a fine of £5, in addition to forfeiture of the fish. If the act is committed on land belonging to the dwelling-house of the owner, it becomes a misdemeanour, and such a fish-poacher, when caught in the act, may be arrested by anybody. Anglers cannot be arrested, even in the latter case. A number of laws have been passed in regard to fishing for salmon and other freshwater fish, and a close time has been established varying somewhat for different localities, as well for rod-fishing as for net-fishing. In England a licence is generally necessary to fish for salmon, trout, or char (but the salmon licence includes the latter), but not in Scotland. In Scotland the punishment for poaching salmon is a fine not less than 10s. nor more than £5, together with the forfeiture of the fish taken, and the boat, tackle, &c., employed by the poacher, if the sheriff or justice think fit. Anyone not an angler poaching trout or any other freshwater fish renders himself liable to a penalty of £5, besides forfeiting the fish caught. A person who merely angles for trout in places where he has no leave to fish is only liable to an action at law.

Pocahon'tas, a celebrated North American Indian princess, daughter of Powhatan, a warrior of Virginia, born in 1595. She is said to have shown a great friendship for the English who colonized Virginia, and to have prevailed on her father to spare the life of Captain John Smith, his prisoner. After Captain Smith had left the

colony she was kept for some time as a hostage by the English (1612). During this detention she was converted to Christianity and christened Rebecca, and in 1613 was married to John Rolfe, an Englishman, who in 1616 took her on a visit to England. She died the following year, and left one son, who was educated in London, and had many descendants in Virginia.—Cf. E. D. Neill, *Pocahontas and her Companions*.

Pochard (*Nyroca*), a name of ducks inhabiting the Arctic regions, but migrating southwards in winter. They are marine in habits, and feed upon crustaceans, worms, molluscs, and aquatic plants. The flesh of several is much prized as food. A typical form and one of the best known is the *N. ferina*, the common pochard, called also lunbird, red-headed poker, red-headed widgeon or duck. The head and neck are bright chestnut; eyes red; bill long; a broad, transverse, and dark-blue band on the upper mandible; length, 16 to 17 inches; weight, 1 to 2 lb. Other species are the scaup pochard (*N. marila*); the tufted pochard (*N. cristata*); and the canvas-back duck of North America (*N. valisneria*), so highly esteemed by epicures.

Pocklington, an urban district and market town of Yorkshire (East Riding), England; served by the North-Eastern Railway, and by canal to the Derwent. The parish church (All Saints') is mainly in the Early English style. The grammar school was founded in 1515. Pop. 1921 (rural district), 10,897; (urban district), 2600.

Pocock, Edward, an English Oriental scholar, born at Oxford 1604, where he died 1691. He graduated at Oxford, was ordained priest in 1628, and became chaplain to the English factory at Aleppo (1629–36). Laud engaged him to collect manuscripts and coins for the University of Oxford, and in 1636 chose him to fill the newly founded Arabic professorship at that university. He was appointed to the Hebrew chair at Oxford in 1648, together with the rich canonry of Christ Church; but from 1650 to 1660 he was deprived of his church preferment. His works are of great value to Oriental and Biblical students.

Pod, in botany, a general term applied to various forms of seed-vessels of plants, such as the legume, the loment, the siliqua, the silicle, the follicle, the capsule, &c.

Podag'ra is the form of gout which recurs at regular intervals, generally in the spring and autumn, and attacks the joints of the foot, and especially that of the great toe. It causes a sharp, burning pain, aggravated by movement or pressure on the part. The term podagra is not now used much.

Podar'gus, a genus of Australasian nocturnal birds of the goatsucker family. Like the goatsuckers, their mouths have a very wide gape. By

day they are excessively drowsy. There are several species, one of which, Cuvier's podargus (*P. cuvieri*), is known among the Australians by the name of 'more pork' from its strange cry.

Podestà, an Italian word derived from the Lat. *potestas*, power, equivalent in its original meaning to a holder of power or authority. In the Middle Ages the podestà wielded almost dictatorial power in many of the Italian cities. In the modern Kingdom of Italy he is the chief official of a commune, corresponding to the French *maire*.

Podgorit'za, formerly a Turkish stronghold against Montenegro, but incorporated with that principality (1880), and now a part of Yugoslavia. It lies about 35 miles north of Scutari, at the foot of a range of mountains, and is the largest town of Montenegro. In the European War it was invested by the Austrians in 1916, and fell to the Allies in Nov., 1918. Pop. 15,000.

Podiebrad (pod'ye-brad), George, King of Bohemia, born 1420 of a noble family, died 1471. When a mere youth he entered into the Hussite movement against Austria. In 1453 he was acknowledged Regent of Bohemia during the minority of the young King Ladislas, and on the death of the latter in 1457 became King of Bohemia. He strove to bring about a peaceful settlement of religious discussions, but failed in his endeavours, and was excommunicated by Pope Paul II in 1465. At the instigation of the Pope, Matthias Corvinus, King of Hungary and son-in-law of Podiebrad, invaded Bohemia, but was defeated and sued for peace.

Podolia, a government of South-Western Russia; area, 16,224 sq. miles. The country is mostly flat, but a low branch of the Carpathians extends through it in an easterly direction. The principal rivers are the Dniester and the Bug. Podolia forms one of the most valuable agricultural possessions of Russia. Manufactures include beet-sugar, spirits, flour, and tobacco. Pop. 4,000,000. Capital, Kamenetz-Podolsk.

Podophthal'mata ('stalk-eyed'), a division of the higher Crustacea, primarily distinguished by compound eyes supported upon movable stalks termed *peduncles*. This division includes the orders Stomapoda and Decapoda, the former of which is represented by the 'locust' shrimps, whilst the latter includes the familiar crabs, lobsters, common shrimps, hermit crabs, and their allies. See *Crustacea*; *Shrimp*.

Podoph'yllin, a resin obtained from the root-stock of the may-apple (*Podophyllum peltatum*; see *May-apple*). It is of a brownish-yellow colour, dissolves readily in alcohol, and has been admitted to the pharmacopœias of many countries as a purgative; it is particularly beneficial in cases of sluggish liver, having much

the same effect as mercury, but in some constitutions produces severe griping.

Podostemaceæ, a small but remarkable natural order of polypetalous dicotyledons, allied to Saxifragaceæ. The species are found on rocks in swiftly flowing water, and are the only Flowering Plants capable of growing under these conditions. They consist of little but submerged flattened green roots, which perform all the vegetative functions, and in due course bear short-lived aerial flowering shoots.

Podu'ridæ, a family of apterous (wingless) insects, belonging to the sub-ord. Collembola, distinguished by the possession of an elastic forked caudal appendage, which is folded under the body when at rest, and by the sudden extension of which they are enabled to effect considerable leaps; hence their popular name of spring-tails. Their scales are favourite test objects for microscopes.

Poe, Edgar Allan, American poet and romantic writer, born at Boston 1809, died at Baltimore 1849. His father and mother were actors, and being left an orphan when a mere child, he was adopted by Mr. Allan, a wealthy Richmond merchant, who resided in England from 1815 to 1820, and sent young Poe to school at Stoke-Newington. On his return to America he attended a school at Richmond, Virginia, and finally entered the University of Virginia (1826). Here he displayed great talents, but also contracted a taste for fast living which occasioned quarrels with his benefactor, and caused him to run away to Boston, where he published a booklet containing *Tamerlane* and other poems. He was next a private soldier for over a year. In 1829 a reconciliation with Mr. Allan took place, and he was sent as cadet to the military academy at West Point. Further irregularities brought about his expulsion, and also a complete rupture with Mr. Allan. His literary career may be said to have begun in 1833, when he gained the prize offered by the *Baltimore Saturday Visitor* for a tale. He then became successively editor of the newly founded *Southern Literary Messenger* at Richmond, contributor to the *New York Review*, and editor of Burton's *Gentleman's Magazine* and *Graham's Magazine* at Philadelphia. For these periodicals he wrote a number of tales, exhibiting a weird yet fascinating imagination. While at Richmond, in 1836, he married his cousin, Virginia Clemm. The great event in Poe's life was the publication at New York in 1845 of his poem *The Raven*, which spread his fame to the whole English-speaking world. He was subsequently connected with *The Home Journal* and *The Broadway Journal* (at New York). Other poems of this or a later period were *The Bells*, *Ulalume*, *Annabel Lee*, and *To*

Annie. In 1847 his wife died. Passing through Baltimore in 1849, on his way to New York to make preparations for a second marriage, he was led to excessive drinking, and died from its effects at the hospital. Among his most noteworthy tales are: *The Gold Bug*, *The Fall of the House of Usher*, *The Murders in the Rue Morgue*, and *The Descent into the Maelstrom*. Poe's career is sad enough, and his faults were sufficiently numerous, but the public were led to believe by Rufus Griswold, his first biographer, that his character was blacker than it really seems to have been.—BIBLIOGRAPHY: J. H. Ingram, *Edgar Allan Poe: his Life, Letters, and Opinions*; G. E. Woodberry, *Life of E. A. Poe*; L. N. Chase, *Poe and his Poetry*.

Poe'rio, Carlo, Italian statesman, born at Naples 1808, died at Florence 1867. Like his father Giuseppe Poerio, he often opposed the actions of the Bourbon kings of Naples, and frequently devoted his talents as an advocate to the cause of political offenders. He thus became a suspect, and from 1837 to 1848 suffered various terms of imprisonment. The Revolution of the latter year released him from prison and placed him at the head of the Neapolitan police and of the Ministry of Public Instruction, but finding it impossible to get the Bourbons to fulfil their promises, he resigned. He sat in the new Parliament and acted with the Opposition. In July, 1849, he was arrested and condemned without defence to twenty-four years' imprisonment. The barbarous treatment he received in prison gave occasion to Gladstone's famous *Two Letters to Lord Aberdeen*, written in 1851 from Naples. In 1859 his sentence was commuted to transportation to South America; but he and his companions in misfortune effected a landing at Cork, in Ireland, and thence proceeded to London. In 1861 he was elected vice-president of the Italian Chamber of Deputies, and remained till his death one of the chiefs of the constitutional liberal party.

Poetry. It is notoriously difficult to define poetry. Many attempts at so doing have been made with very little success. Matthew Arnold called it "a criticism of life". Carlyle said that "all poetry, if we go to that with it, is but a giving of names"; in which case Adam must have been the earliest and greatest poet. Watts-Dunton gave a carefully thought-out definition: "Absolute poetry is the concrete and artistic expression of the human mind in emotional and rhythmical language". St. Augustine called poetry "devils' wine", and Wordsworth called it "the breath and finer spirit of all knowledge". Dr. Johnson defined poetry as "the art of uniting pleasure with truth, by calling imagination to the help of reason". "What is poetry", wrote Mill, "but the thought and

ords in which emotion spontaneously embodies self." According to Coleridge, poetry is "a species of composition opposed to science, as having intellectual pleasure for its object and as attaining its end by means of language natural to us in a state of excitement". "True poetry", wrote Goethe, "is an earthly gospel setting us free, by an inner serenity and outward soothing effect from the burdens of life." Hazlitt defined poetry, in its matter and form, as "natural imagery or feeling combined with passion and fancy. It is the universal language which the heart holds with nature itself." For Shelley poetry is "that which lifts the veil from the hidden beauty of the world", whilst Poe called it "a rhythmical creation of beauty". The *New English Dictionary* defines it as "The expression or embodiment of beautiful or elevated thought, imagination, or feeling, in language adapted to stir the imagination and motions, both immediately and also through the harmonic suggestions latent in or implied by the words and connections of words actually used, such language containing a rhythmical element, and having usually a metrical form". Although it is so hard to give a definition of poetry, most men have little difficulty in recognizing it when they see it. It is, however, customary to apply the term 'poetry' only to the loftier and more successful specimens of the poetic art. Poetry which is of a less elevated kind, or which is full of errors in technique, is usually known as verse.

Aristotle has said that all poetry, of whatever kind it may be, is a mode of imitation. Man is the most imitative of living creatures, and takes pleasure in seeing things imitated. Imitation is one instinct of our nature; another deeply rooted instinct is love of rhythm and harmony. Poetry has sprung from these two instincts.

Broadly speaking, poetry is the emotional and imaginative interpretation of life, just as literature is an interpretation of life. The poet goes to the essence of life, penetrates reality, apprehends facts emotionally, and communicates the feelings aroused in him to his listeners. In his interpretation of life emotion and imagination predominate, and he appeals to our feelings and passions through the medium of rhythmical language, the natural speech of excitement. When man is excited, swayed by feeling or passion, his language—the vehicle by which he expresses his thoughts and communicates them to others—becomes rhythmical, for exalted moods and a state of ecstasy stimulate such language, as in the case of orators. Thus one of the chief traits of poetry is that it peculiarly affects the imagination and the feelings. When we speak of actions or the creations of genius as poetical, the term

implies that they had their origin in conceptions in which imagination and the feelings were chief agents. Hence the universality of poetry, hence the preponderance of the poetical in the language of early nations, when man for the first time began to express vivid emotions and daring conceptions in words. A common idea, the result of experience and reasoning, may be conceived by the poet in such a way as to strike our feelings with peculiar force; or ideas which, though elevated in themselves are familiar to all, may receive new impressiveness from a new and striking way of expressing them. It is gratifying to find a new conception of a familiar idea presenting the subject in a light in which we had never viewed it. "Poets", wrote Shelley, "make things familiar look unfamiliar." They "see the world in a grain of sand, and a heaven in a wild flower". Grasping the mystery and beauty of things, the poet interprets them in his own individual way, but always stimulated by emotions and aided by imagination. He becomes not only "a dreamer after dark", but "a speaker of essential truth". He speaks in rhythm, because, as Browning once said, "his brain beats in rhythm". But mere rhythmical language does not yet constitute poetry, for impassioned prose is also rhythmical. Poetry is more than rhythmical language, it is, to borrow Professor Mackail's expression, "rhythm in verses". Just, however, as impassioned language, coloured words, and the "purple patches" against which Horace warned poets do not constitute poetry, so is a treatise on agriculture in verse not a poetical creation. It is the union between imagination and emotion on the one hand, and rhythm in verse on the other, which constitutes poetry. Although, as an art, the chief function of poetry is to give æsthetic pleasure, and, like music, it addresses itself to the ear, true poetry appeals not only to our feelings and senses, but also to our intellect. It creates beauty, but it also stimulates thought.

According to its subjects, and the relation which the poet holds to his productions, poetry is divided into the poetry of subjective feeling, or lyrical poetry; narrative poetry, including the ballad and the epic; dramatic poetry; didactic poetry, presenting science or art under their beautiful and generally attractive aspects; and satirical poetry.

The theory of poetry, or its philosophy, is called *poetics*. It is one of the theories earliest developed, and æsthetics grew out of it. Among the Greeks Aristotle treated it in his *Peri poiêtikês*; among the Romans Horace, in his *Ars Poetica*, or *Letter to the Pisos*, deals with the subject more briefly. In modern times it has been treated by Vida, Torquato Tasso, and many other Italians; by Boileau, Scaliger, Racine,

D'Alembert, Marmontel, Baumgarten (the founder of aesthetics), Lessing, Klopstock, W. von Humboldt, Herder, Schiller, Goethe, the Schlegels, Hegel, and others; in English by Blair, Wordsworth, Campbell, Hazlitt, and others.

We may divide the history of poetry into two periods: the one before the birth of Christ, the other since. The Hebrews are the first people from whom poetical productions have descended to our times. Only obscure traces remain of any earlier poetry of the Indians, Persians, Syrians, and Arabians. The religious poetry of the Hebrews is of very ancient date, and possesses a solemn character, distinct from that of the other nations of antiquity. It begins with cosmogony, becomes at a later period of a warlike character, then assumes the form of sacred songs in the time of David, and attains under Solomon (from 1044 to 975) its greatest elevation, after which it assumes a prophetic character. The fragments which have come down to us from the flourishing period of Indian poetry, some centuries before Christ, are of an original character and peculiar delicacy. We next come to classic antiquity, and become acquainted with poetry in the plastic character which it assumed in Asia Minor and Greece, under the influence of the prevailing paganism, which received such rich and various hues from the glowing imagination of the people. Greek poetry may again be divided into three periods: the first of these extends from the earliest times of Greece to the Persian wars. The poetry of the Greeks begins in Thrace and Asia Minor, and the great national epics of Homer, or the Homeridæ, the rhapsodists, the cyclic and gnomic poets, indicate a wide diffusion of poetry at that time. Lyric poetry soon attained a peculiar eminence. The second period extends from the Persian wars to the time of Alexander the Great. It is the flourishing period of the dramatic art, and of cultivated Greek poetry in general. The third period shows the decline of Greek poetry under the successors of Alexander, and the revival of the same in Alexandria.

The language of the Romans was not employed in poetry till a late period, and until the Second Punic War, or until the time in which they became closely connected with the Greeks, the Romans made only rude essays in poetry. The era of Augustus was the golden age of their poetry, and it thereafter declined steadily until the introduction of the Christian religion and the irruption of the barbarians. When the Christian religion became prevalent, we find the Latin language applied in Christian worship to a mystic religious poetry; and later, in the ninth, tenth, and succeeding centuries, employed by learned men in imitations of the old

Roman poetry. Contemporary with these we witness the rise of Arabian poetry. A peculiar poetry sprang up among the French, in the time of the Provençals or Troubadours of the south, and the Trouvères of the north, in the eleventh century. In its devotion, valour, and love the spirit of chivalry is apparent. This romantic poetry of the Franks declined into mere artificial rhyming after the end of the twelfth century. Under the dominion of Francis I poetry somewhat revived; but the age of Louis XIV was the golden era of French poetry, although it often, but in its own manner, imitated the ancients and modernized ancient materials. Rhetorical elegance and easy wit were its chief aim. Modern Italian poetry sprang from the Provençal. But a poetry of a natural character began in Sicily after the thirteenth century, and flourished, peculiarly from the time of Dante and Petrarch to that of Ariosto and Tasso, in the thirteenth, fourteenth, and fifteenth centuries, and thence declined into bombast and imitation. Spanish poetry was originally a branch of Provençal; and the earliest Castilian poetry, properly so called, belongs to the thirteenth century; but it began to flourish under the administration of Charles I, and declined under Philip IV. Simultaneous with it, and in connection with it, flourished Portuguese poetry. German poetry, which is closely connected with the northern, and has its own epic cycle, flourished at various times, and with much variety of character, but most vigorously when free from the influence of foreign models. The origin of English and Scottish poetry is lost, like that of the German, in the distant period of the bards; it was refined by the Norman-French poetry. But the flourishing period of English poetry is placed in the times of Queen Elizabeth, although Chaucer is considered the father of modern English poetry. The Scandinavian poetry presents chivalry peculiarly coloured by the northern character, since the thirteenth century, when the German *Heldenbuch* (Book of Heroes) was introduced into Norway, and foreign tales became blended with native ones.—BIBLIOGRAPHY: Matthew Arnold, *Essays in Criticism*; Bliss Perry, *A Study of Poetry*; J. C. Shairp, *Aspects of Poetry*; A. S. Cook, *The Art of Poetry*; W. H. Hudson, *An Introduction to the Study of Literature*; Sir Philip Sidney, *The Defense of Poesie*; Gayley and Scott, *Introduction to the Methods and Materials of Literary Criticism*; G. Saintsbury, *History of Criticism*.

Poggio Bracciolini (pod'jō brāt-chō-lē'ni), Italian scholar and author, born 1380, died 1459. He came early under the influence of the revival of literature kindled in Italy by Petrarch and Boccaccio. About 1402 he became

writer of the apostolic letters under Boniface IX, and for fifty years remained connected with the Papal curia in posts of confidence and dignity. He was a great enthusiast for literature, and unearthed a mass of valuable works which hitherto had been unknown. His own writings embrace a variety of subjects, ranging from moral essays on the miseries of human life and the vicissitudes of fortune, to improper *fabliaux* in Latin, and he excelled as a polemical writer.

Pogroms, a term applied to anti-Jewish riots and massacres taking place in Russia from time to time. Although the Jews have suffered in that country at various times, pogroms may be said to have become a regular feature since 1881, after the assassination of Alexander II. Anxious to turn the public discontent into another channel, and to divert the thoughts of the people from revolutionary propaganda to race-hatred, the Government frequently arranged pogroms, and made the Jews the scapegoats of a reactionary policy. Terrible pogroms took place at Kishinev, in Bessarabia, in 1903, and again in 1905, after the October Manifesto, when Tsar Nicholas II had promised his country a Constitution. Pogroms have unfortunately not ceased even after the Revolution of 1917, and have been of frequent occurrence under the Soviet régime and the rule of the Bolsheviks.

Poincaré, Jules Henri, French mathematician, was born at Nancy in 1854, and died in 1912. After passing through the Polytechnic School and the School of Mines, he was engaged for a year or two as a mining-engineer at Versoul. Having obtained his doctorate in mathematical science, he became a lecturer at the Polytechnic School in 1883, and remained there till 1897. In 1886 he was appointed to the professorship of mathematical physics at the Sorbonne, and in 1896 to that of celestial mechanics. He was elected to the Academy in 1887. In 1889 he carried off the great prize offered by the King of Sweden for competition among the mathematicians of Europe, with a memoir on the problem of three bodies. The award was made by an international jury, who were guided by a report drawn up by Weierstrass. From that time Poincaré was regarded by general consent as the ablest mathematician of his day. His researches cover nearly the whole range of mathematics and mathematical physics. He also earned high distinction as a philosopher, being one of a small band of mathematicians whose work forms perhaps the most notable recent contribution to philosophy. He had a happy knack of popular writing, and his expositions of recent advances in physical science have had a wide circulation. Poincaré's most important work is scattered over innumerable mathematical journals. Among his books are: *Théorie des fonctions fuchsienues*,

Cours de physique mathématique (13 vols.), *Méthodes nouvelles de la mécanique céleste*, *Oscillations électriques*, *Théorie de Maxwell et les oscillations hertziennes*, *Théorie du potentiel newtonien*, *Calcul des probabilités*, *Science et hypothèse*, *La Valeur de la science*.

Poincaré, Raymond, ninth President of the French Republic, was born at Bar-le-Duc, in Lorraine, on 20th Aug., 1860, the son of a civil engineer. He is a member of a family of distinguished scholars, lawyers, and scientists; his brother Lucien was an eminent physicist, and Jules Henri Poincaré, the mathematician, was his cousin. Educated at Bar-le-Duc and at the Lycée Henri IV in Paris, he studied law, a profession chosen for him by his mother. At the boarding-house in the Latin Quarter where he lived he met Gabriel Hanotaux and Alexandre Millerand, with whom he formed a strong friendship. He practised the legal profession for some time, contributing at the same time articles and poems to the *Echo de l'Est*, the *Voltaire* (under the pseudonym of Jacques Aubertin), and to the *République Française*. A brilliant orator, noted for style and perfect form in his speeches, he soon gained distinction in his career. His future, however, lay neither in the legal profession nor in literature, but in politics. Elected to the Chamber of Deputies in 1887, he made his first speech in defence of the Budget presented by Rouvier. He refused the portfolio of Minister of Finance offered to him by Méline in 1893, but accepted that of Minister of Public Instruction in the Dupuy Cabinet in April of the same year. In 1894 he was Minister of Finance, an office in which he greatly distinguished himself. In 1903 he was elected to the Senate, and in 1912 he succeeded M. Caillaux as Premier, Bourgeois, Briand, Millerand, and Barthou consenting to collaborate with him, Poincaré himself assuming the portfolio of Foreign Affairs. Whilst vigorously supporting the French Alliance with Russia and the *entente cordiale* with England, he advocated the necessity for keeping the military and naval forces of France in a state of efficiency. In Jan., 1913, he was elected President of the French Republic, and the election was hailed with enthusiasm not only by the Nationalist party, but by the country in general.

Ominous signs were already appearing on the political horizon of Europe, and a conflagration in the East seemed inevitable. It was therefore of paramount importance for France to have at the Élysée a man who was not a mere figure-head, but a statesman whose characteristics were a clear conception of government, a high intelligence, and energy and will-power in cases of emergency. The country was not deceived. The President's personal influence

made itself felt in various important measures, and particularly in foreign affairs. Poincaré was indeed the first President of the third Republic to exercise considerable political influence. During the European War he was indefatigable. By his brilliant speeches he fanned the flame of patriotism of his countrymen, and by his optimism he inspired hope in those pessimists who frequently were on the verge of despair.

When he thought that the hour of Clemenceau had arrived, and that no one else was capable of carrying the war to a successful issue, he did not hesitate to call to power his former political opponent. He had the supreme satisfaction of seeing Alsace-Lorraine restored to France during his presidency. When his term of office expired in 1920, Poincaré did not retire from public life, but returned to the Senate as member for the Meuse. He was elected to the Académie Française in 1909, and in 1914 the honour of being made Rector of the University of Glasgow was conferred upon him. A clever lawyer, a brilliant orator, a distinguished writer, and a skilful politician, Poincaré was one of France's greatest Presidents. On the 10th Feb., 1920, the Chamber of Deputies paid him the homage of deciding to inscribe his name among those Frenchmen "who had deserved well of their country".

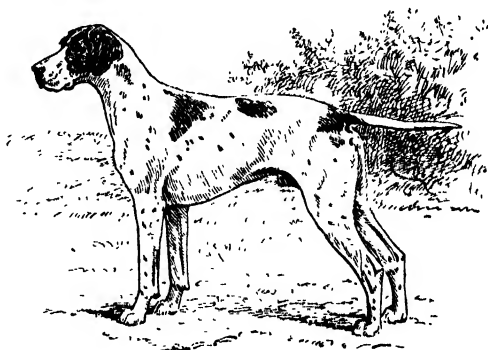
During 1920-1 Poincaré's vast influence in French politics was exemplified in the 'campaign of hate' against Germany, which he personally fomented, and which eventually narrowed down to a criticism of the policy of Lloyd George and his alleged leniency towards Germany, particularly in the matter of reparations. Poincaré was all for the aggrandizement of France and the humiliation of Germany, anxious to take a terrible revenge for the bitter cup of sorrow the German War Lords had forced France to drink to the dregs, in the closing days of the tottering empire of the last Napoleon. As a result, during the Cannes Conference of 1922, Briand was compelled to return to Paris to give an account of his premiership and to explain away, if he could, the proposed Anglo-French Treaty of Defence. On 13th Jan. Briand resigned, and Poincaré was asked by President Millerand to form a new Cabinet. On 15th Jan. the Poincaré Cabinet had taken up the reins of government, and a decided nationalist policy was pursued under that minister's able hegemony. His works include: *Idées contemporaines* (1906), *Questions et figures politiques* (1907), and *Comment la France est gouvernée*.—Cf. Henri Girard, *Raymond Poincaré*; Raymond Poincaré: a Sketch (anonymous).

Poinsettia, the *Euphorbia pulcherrima*, a Mexican plant in general cultivation in greenhouses, conspicuous for the large and brilliant

red floral leaves (flower-like leafy bracts) surrounding its small yellow flowers. It is named after Joel Poinsett, United States minister to Mexico, who first introduced it.

Pointe-à-Pitre (pwant-à-pē-tr), the principal port of the French West Indian island Guadeloupe, on the south-west coast of Grande-Terre, and one of the most important commercial towns of the Antilles. There is a fine harbour, and sugar, cacao, and vanilla are traded. The town, mostly built of wood, was destroyed by fire in 1780, by an earthquake in 1843, and again by fire in 1871. Pop. (1921), 27,680.

Pointer, a breed of sporting dogs, nearly allied to the true hounds. The original breed is



Pointer

Spanish, but a cross with the fox-hound is now generally used. It is smooth, short-haired, generally marked black and white like the fox-hound, but occasionally a uniform black. It derives its name from its habit of stopping and pointing with the head in the direction of game, discovered by a very acute sense of smell. The dog once having pointed remains perfectly quiet. This faculty in the pointer is hereditary, but is better developed by training.

Poison. See *Toxicology*.

Poison-gas Warfare. Poison gases have introduced great problems in warfare, because they can be made secretly in large quantities at short notice by modifying the chemical processes essential in industry, especially those used in dye manufacture. A nation like Germany, with almost a monopoly to-day in the making of dyes, would have an enormous and perhaps a decisive advantage in making war; therefore, whatever the economic sacrifice entailed, it is essential for the safety of ourselves and the other nations to build up strong dye industries.

The Germans first employed poison-gas clouds against the French on 22nd April, 1915 (on a 4-mile front north of the Ypres salient); two days later they attacked the Canadians in the

same manner. This use of poisons was a direct violation of the Conventions signed by Germany at The Hague. Fortunately for the British and the Entente, although there is evidence that the Germans had made considerable preparations for chemical warfare, they had not evolved a suitable technique, for had they then understood the possibilities of this new weapon, they might well have obtained a decision by their treachery.

The Germans generated their cloud by means of cylinders emplaced in the front-line trenches, and discharged through pipes pushed through the parapet. The cylinders had a siphon tube going to the bottom, and the chlorine was expelled by its own vapour pressure, just as soda-water is expelled by the carbonic acid gas in the siphon.

As the opposing trench lines were by no means regular, but consisted of a series of salients and re-entrants, the possible wind directions which would carry gas from one small part of the German (or Allied) front line to the opposing front line were extremely circumscribed, and were unsuitable on the next small section of front; therefore it was impossible to make a gas-attack by means of cylinders so emplaced on a sufficiently long front to enable the attacking troops to break through and win a decisive battle. As the use of poisons was contrary to Article 23 (*a* and *e*) of The Hague Conventions, and the International Declaration of 29th July, 1899, forbidding the use of projectiles having for their 'sole object' the spreading of 'deleterious and asphyxiating gases', neither the English nor the French had made preparation for nor considered the use of anything beyond lachrymators or tear gases (which would put men temporarily out of action without causing them permanent injury). The Germans first used chlorine, an exceedingly cruel poison, but effective only against men devoid of any form of protection.

In Germany chlorine was one of the chemicals required for the dye industries, but in England and France only very small quantities were manufactured in peace-time, and the Allies were forced to build special factories immediately in order to retaliate. In retaliating, the Allied staffs decided to copy the German methods and the gas used, chlorine, and the first British gas-attack took place on 25th Sept., 1915, as part of the preparation for the Loos offensive. During 1916 phosgene (carbonyl chloride), which is far more toxic, was used in the same manner as chlorine, but owing to the low vapour pressure of phosgene at ordinary temperatures, it was necessary to dilute the phosgene with 50 per cent of chlorine in order to expel it from the cylinders and to atomize it at the nozzle.

Apart from using gas in the form of wind-borne clouds produced by cylinders, in 1915 the Germans commenced to fill shells with lethal gases, and the tactical advantages of gas-shell proved so great for blanketing enemy batteries during an attack, harrying reliefs, disorganizing rail-heads and transport, as well as in battle, that its employment increased enormously as the war progressed, and led in turn to the production of special gases for each particular purpose, such as the celebrated ypérite or 'mustard gas' (dichloroethyl sulphide), a liquid which remained a long while on the ground evaporating slowly, and had a most insidious action on the eyes and lungs, causing temporary or permanent blindness after exposure to a very low concentration, and blisters on the skin which, though they did not appear at once, were most painful, disabling, and slow to heal.

The nature of gas-clouds showed that, while the use of cylinders from trenches was a poor method of producing them, it was impossible, by means of artillery shell, to generate clouds which would not only be lethal on the area of initiation, but which would travel long distances and remain lethal. The failure was due to the small capacity of the shell. The stresses on a shell fired from a gun being very great, the walls of the shell have to be thick. Hence the volume available for gas is small, so that the weight of gas thrown is insignificant in comparison with the weight of the shell, and the cost is high in proportion to the result. There is a further difficulty. The thick walls of the shell necessitate powerful bursting charges, which dissipate the gas. For these reasons ypérite was by far the most successful gas-shell filling, and ypérite was not a gas at all, but a liquid of high boiling-point (217° C.) which vaporized very slowly. Only 3 per cent of the casualties due to ypérite died, but the casualties caused were far more numerous, proportionately, than those from shells with more lethal fillings, because even with the most deadly of gases it was never possible to concentrate sufficient guns on an area to produce a cloud which would travel and kill.

For gas-cloud attacks the cylinder method, therefore, held the field for some time. General wind forecasts were given by the meteorologists during the war with astonishing accuracy, but to forecast with certainty the precise wind-direction in a given locality days ahead was impossible. Consequently, apart from the objections already enumerated, the tactical value of this method was much diminished, owing to the uncertainty whether the operation could be carried through at a given time. It was plain, therefore, that if the advantages of large lethal clouds travelling several miles over the enemy

position were to be obtained with reasonable certainty at a given time, so that they would be of tactical use, the cloud must be developed on the enemy's position and not just in front of the attacking troops. The Livens Projector (invented by Captain W. H. Livens, R.E., first used in 1916) was the means by which an entirely new form of bombardment and cloud-gas technique became possible. Projectors were very light muzzle-loading mortars electrically fired, so designed that they could be manufactured cheaply and rapidly in enormous numbers. The gas was contained in a light steel drum or bomb weighing only 65 lb., which was easily carried by one man, and yet was strong enough for ranges of over a mile. The projectors were emplaced touching each other in long, shallow trenches in rows, small steel base-plates preventing the recoil burying the mortar-tube too deeply. They were fired in salvos, the maximum salvo recorded being over 6000 drums, which would generate a cloud containing nearly 100 tons weight of gas. Captured German orders showed that the danger-zone from these clouds extended for over 10 kilometres (or 7 miles from the area of origin), and such concentrations of gas were produced by these salvos that the Germans were killed in many cases before they could put on their gas-masks, or in spite of such protection as their gas-masks afforded them. The Allies manufactured more than 200,000 Livens Projectors during the war, and, in spite of the German advantage in gas-manufacturing capacity, this invention gave the Allies the initiative in cloud-gas warfare.

The gases used during the war may be divided into three classes.

(a) *Non-lethal irritants*, the first gases considered by the English and French. The chief of these were *lachrymators*, remaining a long while on the ground and evaporating slowly, acting on the eyes, and usually persistent. They had an iodine or bromine base, the best known being *ethyl iodacetate*, *benzyl* and *xylyl bromide*, and *brominated ketones*, the last three chiefly used by the Germans.

(b) *Lethal irritants*, acting on the mucous membranes, eyes, and skin. The chief examples used by the Germans, and the date from which they were used, are as follows:

Persistent: 'mustard oil' (*dichlorodiethyl sulphide*), boiling-point 217° C. (July, 1917).

Non-persistent: *phenylcarbylamine chloride*, boiling-point, 209° C. (Sept., 1917); *dichloroethylarsine*, boiling-point, 156° C.; *diphenylchlorarsine*, solid, melting-point, 46° C., in German 'Blue Cross' shell; *diphenylcyanoarsine*, melting-point, 23° C., in German 'Blue Cross' shell; *chloropicrin* (usually mixed with phosgene or stannic chloride); *chlorine* (the first cloud-gas used).

(c) *Lethal and non-persistent*: *phosgene* (*carbonyl chloride*), used much in cloud form as well as for filling trench-mortar bombs and shells, very lethal, with a curious delayed action; *trichloromethyl chloroformate* and *chloromethyl chloroformate*, German 'Green Cross' shell fillings similar to phosgene in effect; *cyanogen compounds*, immediately fatal in concentrations of 1 : 1000 air, but unstable and not dense enough for the cloud to travel.

Protection against Gas.—The first gas-masks (improved by Sir William Ramsay the day of the original German attack) were bands or

mouth-pads of flannel or wool, worn across the face and tied behind the head; these were soaked in hyposulphite of soda, to which a little glycerine was added so that they would keep moist; these masks gave very fair protection against low concentrations of chlorine.

There is a cast of a dead body in the museum at Pompeii showing a similar type of improvised gas-mask, which brought home to the writer the fact, not generally realized, that the great death-roll in that catastrophe of ancient times was not due to the lava stream, or even the shower of ashes, but to the vast discharge of sulphur gases carried by the wind from the mountain over the doomed cities.

All the gas-masks used during the war were really filters, which removed the poisons from the air breathed by the man, but did not supply him with air to breathe (as oxygen apparatus does), and the list of gases which were used will make clear the difficulties in devising a mask which would give perfect protection against them all, remain efficient under active-service conditions, and be neither heavy nor bulky. The English respirator adopted finally consisted of a cylindrical container filled with vegetable charcoal, made from the hardest and densest nut-shells or fruit-stones available, and soda-lime-permanganate granules, with other chemicals introduced into the granules as required to absorb the various new gases as they were brought out. This cylinder was connected by a tube, with a face-piece or mask fitting tightly over the face. Rubber inlet and outlet valves prevented air reaching the lungs without passing through the filter on inspiration, and prevented the moist air, expelled by the lungs on expiration, from traversing the filter and lowering its efficiency. This mask, which was more efficient and more adaptable than the German device, the Allies owed to the work of Major Bertram Lambert at Oxford, in devising the granules; to the organizing genius of the late Colonel E. F. Harrison; and to the vision and foresight of General H. F. Thuillier (then Director of Gas Services in France, and later Controller of the Chemical Warfare Department of the Ministry of Munitions, England). General Hartley's method of protecting dug-outs and gun-positions by a simple and efficient form of blanket-screen also proved valuable. If there is a future war, it may be necessary to protect not only the fighting forces against gas, but the civilian population also. There are many grave difficulties which must be overcome if such protection is to be efficient, for developments during the last years of the past war showed that, in spite of the fact that more casualties were then due to gas than to any other weapon, the possible horrors of future gas-warfare have

only been foreshadowed. In framing international regulations against gas-warfare the difficulty will always remain that, like Germany, any dishonest nation with a chemical industry can secretly prepare an overwhelming chemical offensive against unprotected peoples.—BIBLIOGRAPHY: For further information see *Chemical Warfare* (a paper read by Brigadier-General H. Hartley, C.B.E., M.C., before the British Association, 1919); *Journal of Industrial and Engineering Chemistry*, published by the American Chemical Society (various papers, 1919–20); *The Riddle of the Rhine*, by Major V. Lefebure, O.B.E., a book discussing the menace of the German chemical factories (Collins, 1921); *America's Munitions, 1917–1919*, by the Hon. Benedict Crowell, United States Assistant Secretary of State for War and Director of Munitions Supply.

Poison Ivy, or Poison Oak (*Rhus toxicodendron*), a trailing or climbing shrub of the ord. Terebinthaceæ, found in Canada and the United States.

Poison-nut, a name for *Strychnos nux-vomica*, an evergreen tree of the nat. ord. Loganiaceæ, the seeds of which yield strychnine. (See *Nux-vomica*.) Also a name for the *Tanghinia venenifera*, of the nat. ord. Apocynaceæ, the fruit of which is a drupe enclosing a kernel extremely poisonous. It used to be employed in Madagascar as an ordeal-test of guilt or innocence, the result generally being the death of the suspected person.

Poisonous Plants. The chief British narcotic vegetable poisons are those derived from the plants Monk's-hood or Wolf's-bane, Deadly Nightshade, Belladonna or Dwale, Henbane, and Thorn-apple. The first of these (*Aconitum napellus*) is intensely poisonous, owing to the presence of an alkaloid known as *aconitin*; the chief antidotes are atropine, belladonna, and digitalis. The Deadly Nightshade (*Atropa belladonna*) owes its poisonous properties to the active principle *atropine*. An antidote is tannic acid, 20 grains in water; the stomach should be emptied, and brandy and water given as stimulants. Similar treatment is prescribed in the case of poisoning from the Thorn-apple (*Datura stramonium*). Henbane (*Hyoscyamus niger*) has properties similar to those of belladonna. A considerable number of common British plants contain irritant or narcotico-irritant poisons. Among these is the Cuckoo-pint or Wake-robin (*Arum maculatum*), the remedy for which is castor-oil, hot coffee, stimulants, and warm poulticing. Several well-known members of the ord. Umbelliferae contain a poison whose action starts in the lower limbs; these include the Common or Spotted Hemlock (*Conium maculatum*), the Water Hemlock (*Ci-*

cūta virōsa), the Hemlock Water Dropwort (*Oenanthe crocata*), and the Fool's Parsley (*Æthusa cynapium*). Among their antidotes are oak bark decoction, tannic and gallic acids, hot tea or other similar substances; stimulants should be given. The antidote which is given in the case of Meadow Saffron (*Colchicum autumnale*) is atropine, the stomach having first of all been emptied. For the Woody Nightshade or Bittersweet (*Solanum dulcamara*), castor-oil, stimulants, &c., are prescribed, in addition to the emetics to be employed in all cases. The berries of the Common Privet have also proved fatal. The well-known Foxglove (*Digitalis purpurea*) owes its poisonous character to a powerful principle *digitalin*; the administration of atropine is, as a general rule, all that is needed, and a recumbent position should be maintained. Other poisonous plants are the Cypress Spurge (*Euphorbia cyparissias*), the Pasque-flower (*Anemone pulsatilla*), the Mezercon (*Daphne mezereum*), the Herb Paris (*Paris quadrifolia*), and Laburnum (*Cytisus laburnum*). Mistakes are often made in distinguishing edible from poisonous Fungi. The edible kinds mostly grow solitarily in dry, airy places, while poisonous varieties grow in clusters in woods and damp, dark places. Bright-coloured species should generally be avoided.

Poisson, Siméon Denis, French mathematician, was born in 1781, died 1840. In 1798 he entered the École Polytechnique, where his talent soon showed itself, and I acroix, Legendre, Lagrange, and Laplace all befriended him. He succeeded Fourier as professor at the École Polytechnique in 1808, and in 1809 was appointed first professor of mechanics at the Sorbonne. Poisson published more than three hundred works, some of them elaborate treatises, mostly on mathematical physics.—*Poisson's equation* is an extension of Laplace's equation (q.v.). It is $\frac{d^2V}{dx^2} + \frac{d^2V}{dy^2} + \frac{d^2V}{dz^2} + 4\pi\rho = 0$, where V is the potential (q.v.) at (x, y, z) due to a distribution of electricity of volume density ρ .

Poitiers (pwá-tyä), or **Poictiers**, a city of France, capital of the department of Vienne, on the Clain. The principal edifice is the cathedral (St. Pierre), founded by Henry II of England about 1102.

Poitiers is one of the most ancient towns of France, and the vestiges of a Roman palace, of Roman baths, of an aqueduct, and an amphitheatre still remain. It is named after the Gallic tribe of the *Pictones*. Two famous battles were fought in its vicinity, that in which Charles Martel defeated the Saracen army in 732, and that between the French under their king, John II, and the English under Edward the Black Prince in 1356. Poitiers was capital of the pre-Revolutionary province of Poitou. The

manufactures are unimportant, but there is a large trade. Pop. 41,000.

Poitou (pwà-tô), one of the pre-Revolutionary provinces of France, between Brittany and Anjou on the north, Berry on the east, the Atlantic on the west, and Angoumois and Saintonge on the south. It was divided into Lower Poitou and Upper Poitou, now co-extensive with the provinces of La Vendée and Upper Poitou and with Deux-Sèvres and Vienne respectively. Poitiers was the capital. Henry II of England acquired possession of Poitou by his marriage with Eleanor, heiress of the last Duke of Aquitaine (see *Aquitania*).

Poker, a card game played with a full pack of ordinary playing-cards, generally including the joker, in which the winner is determined by the value of the combinations of cards he holds. The origin of the game is obscure, but it has been more played by Americans than any other people. It is played by two to six people, each receiving five cards from the one whose turn it is to deal. The scale of values of hands runs: *a pair*, e.g. two threes or two jacks; *three of a kind*; *a straight*, five cards in order of value but of various suits; *a flush*, any five cards of the same suit; *a full house*, three of a kind and a pair; *four of a kind*; *a straight flush*, five cards in order of value and of the same suit. If the joker is used, the additional combination *five of a kind* ranks highest of all.

The play varies considerably. After the deal a start is made with small bets, usually to a prescribed limited value. Any player is at liberty to drop out, but if he continues to play he must bring up the value of his stake to the common level. Those still in the game then discard some or all of their five cards, and have others dealt to them to make up their hands. Betting then starts in earnest, each being allowed to raise the bet to any extent up to a certain limit. One after another the players fall out until the betting has reached a satisfying value, when one of the players calls the hands to be shown, and puts in the amount of the last 'raise'. The holder of the best hand takes all stakes, including those forfeited by players falling out. If all but one fall out, the stakes go to the one still in. The game has considerable possibilities of bluffing in it. Stakes can be put up in amounts of such a character as to convince the other players that one's hand is very different from what it is. The game is a dangerous one to play with strangers, as it is one of the most popular with card-markers, card-manipulators, and other American tricksters.—Cf. *The Handbook of Games*, vol. ii (Bohn's Libraries).

Pokeweed, the *Phytolacca decandra*, a North American branching herbaceous plant, ord.

Phytolaccaceæ, which is naturalized in some parts of Europe and Asia. Its root acts as a powerful emetic and cathartic, but its use is attended with narcotic effects. Its berries are said to possess the same quality; they are employed as a remedy for chronic and syphilitic rheumatism, and for allaying syphiloid pains. The leaves are extremely acrid, but the young shoots, which lose this quality by boiling in water, are eaten in the United States.

Pola, a town of Italy, in Istria, on the Adriatic, formerly the principal naval base of Austria-Hungary. It is an ancient place whose authentic history dates back to its capture by the Romans in 179 B.C., and it was for a long time the principal town of Istria. Its former importance is well attested by architectural remains, chief among which are a colossal and well-preserved amphitheatre and two temples. Pola had sunk to the level of a mere fishing-place with some 800 or 900 inhabitants, when, in 1848, the Austrian Government, tempted by excellent harbour accommodation, selected it as their chief naval station, and by the erection of dockyards, of an arsenal, barracks, and other Government establishments, infused new life into it. There are two harbours (naval and mercantile), extensive fortifications, and barracks. During the European War the Italian fleet blockaded an enemy squadron in Pola harbour, and made several raids, in course of one of which an Austrian capital ship was torpedoed. Croatian seamen boarded the surrendered vessels in Oct., 1918, when the Italians raided the harbour again, and precipitated an Italian-Yugo-Slav crisis by destroying the *Viribus Unitis*. By the treaty of 1919 Pola passed definitely to Italy. Pop. 50,000.

Polacca, a three-masted vessel used in the Mediterranean. The fore- and main-masts are usually of one piece, so that they have neither tops, caps, nor cross-trees. It carries a fore-and-aft sail on the mizzen-mast, and square sails on the main-mast and fore-mast.

Poland, a republic of Europe, lying approximately between 48° and 55° N. lat., and between 16° and 28° E. long. It spans the great North European Plain from the Baltic seaboard to the Carpathians, and is broadly a transition area between the German plain in the west and the vast plain of Russia in the east. In the south the frontier follows the crests of the Carpathians, and includes most of the former Austrian province of Galicia; to the east, the frontier marches with that of Russia and the Ukraine via the Pripiet marshes; north is the Baltic. From the Carpathians the boundary follows the water-parting between the Oder and Warthe, crosses the Warthe between Landsberg and Posen, and then curves north-east across the

plain to the coast, a little west of Danzig.

Area and Population.—Poland is the sixth state of Europe in size and population, and is divided into 15 counties and 257 districts as follows:

County.	No. of Districts.	Population, 1921 Census.
1. Warsaw	23	2,111,165
2. Lodz	13	2,256,655
3. Kielce	16	2,537,127
4. Lublin	10	2,090,040
5. Białystok	14	1,295,086
6. Nowogródek	11	1,296,417
7. Wołyń	9	1,501,511
8. Polesia	9	865,035
9. Poznań	36	1,970,822
10. Pomorze	18	941,461
11. Kraków	23	1,986,045
12. Lwów	27	2,724,327
13. Stanisławów	16	1,334,630
14. Tarnopol	17	1,419,355
15. Silesia ¹	6	1,125,537
Military	—	500,000
Total	25,955,223
City of Warsaw	931,176
Grand total population	26,886,399

¹ An area of 1225 sq. miles (pop. 891,690) of Upper Silesia has been allotted to Poland.

The approximate total area of Poland is 150,000 sq. miles.

Towns.—Warsaw is the capital and the principal town; others are: Lodz (pop. 1921, 451,813), Lwów (Lemberg; 220,000), Kraków (Cracow; 176,463), and Poznań (Posen; 156,691).

Physiography.—Poland may be divided into five distinct areas. (1) The mountain area, which falls through forested slopes and upland pastures to (2) the southern plateau, having an average altitude of 900 feet, and bisected by the Vistula. (3) The basin of the Middle Vistula, a low, wooded plain from 300 to 400 feet in altitude, was the cradle of the Polish race. It rises northward to the lake-studded Baltic Plateau, and forms the grain-producing area of Poland. Within recent geological times the whole lowland area was a vast glacial lake, or a series of glacial lakes, and it is to the silt deposits of these lakes that the district owes its modern prosperity. The complicated river-system is also attributed to this geological fact. (4) Separating the Central Plain from the coastal belt rise the Northern Uplands, rounded hills of some 700 feet in height, interspersed with peat-bogs, marshes, sandy areas, and many lakes and ponds, and traversed by slow-flowing rivers. (5) The coastal belt is sandy and shallow, frequently ice-bound in winter. Linking up the first four physical conditions is the Vistula, falling into the sea at Danzig, which, nominally a free and independent port, forms the natural outlet northward for the whole of the Polish plain.

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Climate.—Climatically Poland is also a transition area between the continental climate of Eastern Europe and the more oceanic climate of the West. The mean annual temperature may be as low as 43° F.

Social Conditions: Religion.—There is no national Church, and all denominations are tolerated, but by Article 117 of the Polish Constitution, Roman Catholicism is stated to be the dominant religion, and to that faith 69.2 per cent of the population belong. Others are Greek Catholics (about 12.1 per cent), Jews (about 11.0 per cent), and Protestants.

Education.—Elementary education is free and compulsory. There are five universities (Cracow, Posen, Lublin, Warsaw, and Lemberg), polytechnics at Warsaw and Lemberg, an academy of fine arts, two agricultural colleges, one forestry school, a mining-college, two veterinary colleges, and the Academy of Science (Cracow), the principal scientific institution of Poland.

Money.—The monetary unit is the mark of 100 pfennigs (normally 20.43 marks = £1 sterling). **Weights and Measures.**—The metric system is officially compulsory, but the Polish measures are unofficially used.

Production: Agriculture.—Poland is essentially an agricultural country, and many of her industries, such as sugar-refining, distilling, and starch-making are directly dependent upon other agricultural productivity. Wheat, rye, barley, oats and potatoes, sugar-beet, hemp, hops, tobacco, and chicory are important. **Forestry.**—25 per cent of the productive area of the state is forested, and, under a Bill passed by the *Sejm* (Diet) in July, 1919, all forests were nationalized. **Minerals.**—There are coal-fields, in the Cracow basin, capable of considerable development, but Polish coal-production in general is more or less dependent upon the more rich fields of Upper Silesia in the area allotted to Poland by the League of Nations (i.e. around Königshütte). Small quantities of other minerals are found, especially salt from Wieliczka (near Cracow, in Galicia). Before the European War Galicia produced about 5 per cent of the world's total petroleum output. **Manufactures.**—There are three main groups of industrial centres, and all the industries of Poland are represented in Warsaw, half-way between Cracow and Danzig. These are principally manufactures of paper, and paper-bags of various kinds.

Commerce.—The absence of good strategic frontiers east and west, i.e. at the points of greatest danger, has repeatedly proved a disastrous disadvantage to Poland in her twofold military capacity of (1) buffer between Slav and Teuton, and (2) frontier guard of Europe against Asiatic invaders. But the

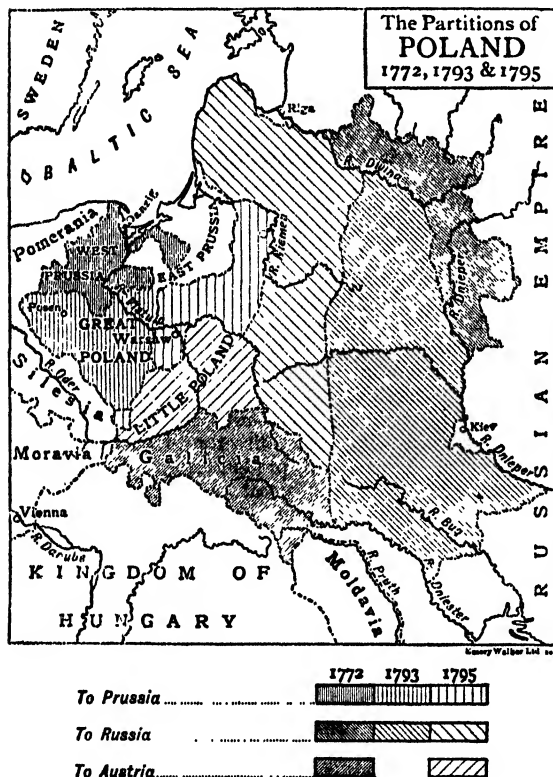
trade relations of the area in peace are exceptionally good. Before the European War the chief exports were (a) manufactured goods, machinery, cotton and woollen goods, and alcoholic beverages to Russia; and (b) grain and farm produce to Germany. Imports were chiefly (a) manufactured goods, such as tools, agricultural machinery, and cutlery; and (b) raw materials, viz. raw wool, cotton, and jute.

Communications.—There are over 7250 miles

(west); Cracow and Przemyśl and armed camps (south); Brest-Litovsk, Grodno, and Osowiec (east); and Warsaw, Modlin, and Deblin (central). A river-fleet of six gunboats and cruisers is intended for the Vistula.

History.—The Poles, like the Russians, are a Slavonic race, and are first spoken of as the Polani, a tribe or people between the Vistula and Oder. The country was divided into small communities until the reign of Mieczysław I

(962–992) of the Piast dynasty, who renounced paganism in favour of Christianity, and was a vassal of the German Emperor. He was succeeded by Bolesław the Great (992–1025), who raised Poland into an independent kingdom and increased its territories. In succeeding reigns the country was involved in war with Germany, the heathen Prussians, the Teutonic knights, and with Russia. The last of the Piast dynasty was Casimir the Great (1304–70), during whose reign the material prosperity of Poland greatly increased. He was succeeded by his nephew, Louis of Anjou, King of Hungary, whose daughter Hedwig was recognized as queen in 1384, and having married Jagello, Prince of Lithuania, thus established the dynasty of the Jagellons, which lasted from 1386 to 1572. During this period Poland attained its most powerful and flourishing condition. In 1572 the Jagellon dynasty became extinct in the male line, and the monarchy, hitherto elective in theory, now became so in fact. The more important of the elective kings were Sigismund III (1587–1637), Wladislaw or Ladislaus IV (1632–48), John Casimir (1648–69), and the Polish general Sobieski, who became king under the title of John III (1674–96). He was succeeded by Augustus II, Elector of Saxony, who got entangled in the war



of State-owned railways (June, 1921), and over 30,000 miles of roads. 1875 miles of navigable water-ways are accessible by vessels of over 400 tons for a distance of 298 miles. By Act of the *Sejm* (Diet), Poland is engaged in the foundation of a national mercantile marine, 20 vessels of 8000 tons each and 10 vessels of 3000 tons each being among the ships provided for.

Defence.—The army is organized on a conscription basis, service being universal and compulsory, and there are nine military districts, viz. Warsaw, Lublin, Kielce, Lodz, Cracow, Lemberg, Posen, Grodno, and Pomorze. The fortresses of Poland are: Thorn and Posen

of Russia with Charles XII, and had as a rival in the kingdom Stanislaus Leszczyński. Augustus III (1733–63) followed, and by the end of his reign internal dissensions and other causes had brought the country into a state of helplessness. In 1772, under the last feeble king, Stanislaus Augustus (1764–95), the first actual partition of Poland took place, when about a third of her territories were seized by Prussia, Austria, and Russia, the respective shares of the spoil being Prussia 13,415 sq. miles, Austria 27,000 sq. miles, and Russia 42,000 sq. miles. What remained to Poland was completely under Russian influence. Another partition in 1793 gave Russia nearly 97,000 sq.

miles and Prussia 22,500 sq. miles. A third partition took place in 1795 after the heroic attempt of Kosciusko to save his country, and the last King of Poland became a pensionary of the Russian court. The successive partitions gave Russia upwards of 180,000 sq. miles, Austria about 45,000 sq. miles, and Prussia 57,000 sq. miles. Napoleon formed the Duchy of Warsaw in 1807, and for a time Poland became a semi-independent state; but the Congress of Vienna in 1815 repartitioned the country, excepting Cracow, which retained its independence until annexed by Austria in 1835. From 1815 to 1830 Russian Poland was a constitutional monarchy with the emperor as king, but the Poles, taking occasion of the French Revolution, at the latter date rashly engaged in an insurrection, which only hastened their complete absorption in Russia.

European War.—Congress Poland was the theatre of war during the first year of the European War (Aug., 1914, to Aug., 1915); Galicia was overrun three times by the Russian and Austrian armies, and for three years the northern provinces were occupied by the Germans and the southern by the Austrians. The Germans drained the country by heavy taxation, export and import duties, and by the large-scale evacuation of industrial plant from towns, factories, and mills. A joint Manifesto of the German and Austrian Emperors proclaimed (5th Nov., 1916) the independence of Poland, and on 9th Nov., 1918, independence was proclaimed. On 14th Nov. Marshal Joseph Pilsudski (q.v.) returned from prison in Magdeburg and convoked the Constituent Assembly, which elected him to the presidency. He was re-elected for a further term on 20th Feb., 1919. The Treaty of Versailles acknowledged the independence of Poland (28th June, 1919). However, as a result of the different policies towards the Poles of the Russian, German, and Austrian Governments during the hundred and twenty-five years since the last partition of Poland, the Poles developed different characteristics in the three provinces. The policy of both the German and the Russian Governments was directed towards excluding the Poles from any participation in the government of the country. In Russia the exclusion was absolute, and in Germany the few Polish Deputies elected to the Reichstag were always attached to the Opposition, and gained no practical experience in government and administration. The Austro-Hungarian province, on the other hand, enjoyed autonomous government under the Galician Diet, located at Lwów (Lemberg) but controlled from Vienna. As a consequence, upon the formation of the Polish State, the Galician Poles, who were the only Poles with any governmental experience, immediately went

into office and organized the Government upon the Austro-Hungarian pattern. M. Paderewski, probably better known as a pianist, was Premier between Feb. and Dec., 1919, when he resigned, and M. Skulski formed a new Ministry (15th Dec.). During 1919 the Polish armies under Pilsudski engaged in three wars with Soviet Russia, the Ukraine, and Czecho-Slovakia respectively. After the Bolsheviks had evacuated Vilna the city was claimed by both Poles and Lithuanians, the former on account of the language and population, and the latter on the grounds of history and tradition. See *Galician Campaign*.

Language and Literature.—The Polish language belongs to the Slavic division of the Aryan or Indo-European tongues. It is remarkable for its flexibility, richness, power, and harmony; its grammatical structure is fully developed and established, and its orthography is precise. The Polish literature reaches back to a more remote period than that of any other Slavonic language except the Bohemian. The oldest monuments consist of warlike, historical, political, and religious poems, more especially the last. The most celebrated of these monuments written in Polish is the *Bogarodzica Dziewica*, a hymn in honour of the Virgin, said to have been composed by Adalbert of Prague at the end of the tenth century. The next literary remains of the country are all in Latin, and consist mostly of chronicles written by the monks, the earliest dating from the twelfth century. Literature again revived in the fourteenth century under Casimir the Great, the founder of the University of Cracow, and the progress of civilization and culture is still more noticeable in the fifteenth century in the works of Jan Dlugosz. The 'golden age' of Polish literature was from 1521 to 1621. To this period belong Nicolas Rej (died 1568) and Jan Kochanowski (died 1584), who both attained eminence as poets, the former in satire, allegory, didactic poetry, &c., the latter as a lyricist of the highest rank. Among the other poets of the century were Szarzynski (died 1581), and Szymonowicz (Simonides), author of *Polish Idylls*. It was in the sixteenth century also that the first histories in the language of the people were written. This flourishing period of Polish literature was followed by a period of Jesuit supremacy and literary decline, which lasted till about the middle of the eighteenth century. About that time the influence of the French civilization was widely felt in Poland, and prepared the way for the revival of letters. The most distinguished authors of the latter part of the eighteenth century are Naruszewicz, who wrote odes, idylls, satires, &c., and Krasicki (1734–1801), who also distinguished himself in various fields. The literary activity of Poland

did not cease after the overthrow of the political independence of the country. It is indeed only after its loss of independence that Poland's literature acquired a European importance. After the year 1815 Vilna became the literary centre of Poland, and here a number of the most enthusiastic spirits of the country associated together and endeavoured to propagate the influence of English and German literature, in opposition to the prevailing French tendencies. Among Polish poets of the nineteenth century may be noted Mickiewicz (1789-1855), Krasinski (1812-59), Slowacki (1809-49), and Zaleski (1802-86). Kraszewski (1812-87), novelist and political and historical writer, was one of the most prolific of Polish authors. In recent times the Polish novel is more representative of the epoch than are Polish drama and poetry. Among the best-known writers are Henryk Sienkiewicz, Eliza Orzeszkowa, and the leader of Young Poland, Stanislaw Przybyszewski, whose works, *The Children of Satan* and *Homo Sapiens*, met with considerable success.

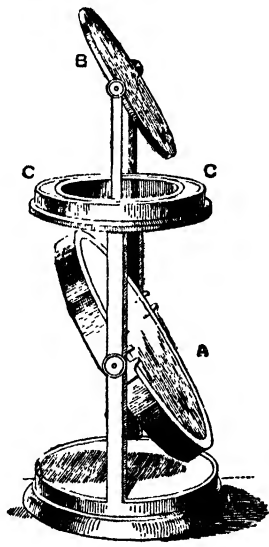
BIBLIOGRAPHY: A. B. Boswell, *Poland and the Poles*; A. S. Rappoport, *History of Poland*; R. N. Bain, *Slavonic Europe*; A. Phillips, *Poland* (Home University Library); *New World of Today* (Gresham Publishing Company); R. E. Kimens, *Economic Report dated March, 1921* (H.M. Stationery Office); J. H. Harley, *Poland, Past and Present*; Lord Eversley, *The Partitions of Poland*; G. M. C. Brandes, *Poland: a Study of the Land, People, and Literature*.

Polariscope, an instrument for exhibiting polarized light, and for examining transparent substances with regard to their polarizing properties. It contains a polarizer A (see fig.), an analyser B, and a platform CC to hold the specimen, and provided with a scale in degrees. The polarizer and analyser are similar in construction, and consist in the simplest form of two glass plates, or, better, two piles of thin glass plates. These plates are set to reflect light at the polarizing angle, viz. $57\frac{1}{2}^\circ$ for glass; and light reflected

from A is directed to B. On examining the light reflected from B, as this plate is rotated round a vertical axis, it is found to be almost extinguished for a given position of B, in which the principal planes (which contain the incident and reflected rays) of the two mirrors are at right angles to each other. On interposing a piece of mica, quartz, or Iceland spar, and rotating the specimen on the platform, the light appears again by reflection from B, and is now coloured. No effect is obtained with unstrained glass or with crystals belonging to the cubical system, such as diamond, and the polariscope may be used to discriminate between 'pebble' and glass lenses, and between real and artificial gems, with the exception mentioned. In another form of polariscope the principle of refraction is employed, and both polarizer and analyser are formed of Nicol prisms. See *Polarization of Light*.

Polarization of Light, an alteration in the properties of light, produced by reflection, or by refraction through certain bodies; the alteration is not visible to the naked eye. When a beam of light falls obliquely on a plane glass surface, part of the light is reflected and part is refracted. Each of the two beams has now different properties from the incident beam; the reflected beam is not reflected from a second surface with equal facility in every direction, but appears bright and dim alternately as the second reflector turns round while keeping the angle of incidence constant. The light is now partially polarized, and polarization attains a maximum for a glass reflector when the angle of incidence is $57\frac{1}{2}^\circ$; this is called the polarizing angle, and Brewster showed that the tangent of the polarizing angle is equal to the refractive index of the reflecting medium. The refracted ray is also partially polarized, and a simple polarizer may be constructed by placing a number of microscope cover glasses in a perforated pill-box, the glasses being set at about 38° to the incident light. The emergent light can then be examined by a similar 'pile of plates' used as an analyser.

Polarization also takes place when light is refracted through certain crystals, or through transparent isotropic substances, such as glass or celluloid, when in a state of strain. Crystals, except those which belong to the regular or isometric system, appear to possess the property of double refraction in some measure, and all rays which are doubly refracted are at the same time polarized. On looking through a rhomb of Iceland spar at a black dot on a white paper, two dots are seen, and on turning the rhomb on the paper, one dot is seen to revolve round the other. One ray obeys the ordinary laws of refraction, and the other does not;



Malus' Polariscopes

hence one is called the ordinary ray, and the other the extraordinary ray. The optical distinction between these two rays is the following. In a ray of common light the ether vibrations are transverse or across the path of the ray, and in every direction, whether in straight, elliptical, or other paths. When a ray of light enters a crystal, the latter constrains the heterogeneous vibrations of the incident light which are resolved into vibrations in two directions only, and rays of plane polarized light emerge. The vibrations in the ordinary ray are perpendicular to the plane of incidence, whilst those of the extraordinary ray take place in this plane and at right angles to those of the ordinary ray. In polarization by reflection the vibrations of the reflected ray are perpendicular to the plane of incidence and parallel to the reflecting surface; the refracted ray is constituted by vibrations perpendicular to this direction in the plane of incidence.

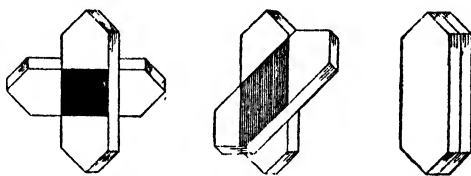
In general, a doubly refracting crystal gives rise to two rays, but all such substances possess one or two directions along which a ray may pass without being broken into two. These directions are called optic axes, and a crystal is said to be uniaxial or biaxial according as it possesses one or two optic axes; Iceland spar and quartz are uniaxial, and nitre and cerussite are examples of biaxial crystals. The optic axis is merely a direction and not a particular path in the crystal. In quartz the axis is perpendicular to the hexagonal section of the crystal; and in Iceland spar or calcite it is equally inclined to the three faces forming the obtuse angle of the rhombic crystal.

Tourmaline is a crystal which possesses a remarkable property; it occurs as green, pink, and brown crystals, of which the brown variety is best suited for polarization experiments. Plates of tourmaline cut parallel to the axis and about $\frac{1}{10}$ inch thick can completely absorb the ordinary ray, and two tourmalines made up in the form of 'tongs' form a convenient small polariscope, giving a dark field when the tourmalines are crossed (see fig.). Another crystal polarizer is made from Iceland spar. The Nicol prism is made from a long rhomb of spar, the end faces of which are cut to make angles of 68° with the two nearest long edges; the rhomb is then cut in halves by a plane perpendicular to the newly cut faces and to the plane containing the two long edges mentioned. The two halves are cemented together again with Canada balsam, which has a refractive index less than that of the extraordinary ray, but greater than that for the ordinary ray. The effect is such that when rays parallel to the long edges pass into the prism by an end face, they are doubly refracted, and the ordinary rays are totally

reflected at the balsam and are absorbed at the side, whilst the extraordinary rays pass through the prism. Two Nicol prisms give, when 'crossed', a dark field, which becomes bright on interposing a doubly refracting crystal. Many beautiful colours may be obtained in this way with thin plates of mica and selenite. A Nicol prism is part of the equipment of the polariscope, saccharimeter, and geologist's microscope.

The optical behaviour of Iceland spar and quartz differs in one important particular. As seen in the Nicol prism, the ordinary ray is refracted more than the extraordinary; but in quartz the opposite is the case. For this reason quartz, ice, and other crystals are termed positive, while Iceland spar, tourmaline, ruby, and others are called negative crystals.

If a plate of quartz or Iceland spar is cut



Polarization of Light

parallel to the axis, and rays fall normally on it, the two polarized rays are not separated in direction, but one travels more slowly than the other, and, their vibrations being at right angles, the resultant motion on emergence is, in general, elliptical, and the emergent light is said to be elliptically polarized. If the difference of phase in the two rays is 90° , and the amplitudes are equal, the emergent ray will be circularly polarized.

Another optical property may be exhibited by means of a plate of quartz cut perpendicular to the axis. When the plate is put between crossed Nicol prisms used with monochromatic light, the light passes through the analyser; it is plane polarized, but its plane of polarization has been rotated on passing through the quartz. Different specimens of quartz are found in which the directions of rotation of the plane of polarization are opposite to one another; these are distinguished as right-handed and left-handed quartz, according as, on looking in the direction in which the ray is travelling, the turning is clockwise or the reverse. A solution of cane-sugar is dextro-rotatory, whilst one of fruit-sugar is larvo-rotatory. Rotatory substances are examined by means of a saccharimeter (q.v.), by which are determined the direction and amount of the rotation; from the observations the amount of active material present may be calculated.

Professor Coker has applied the properties of polarized light as a means of investigating, for engineering purposes, the variations of stress in plates and springs made of xylonite.—BIBLIOGRAPHY: R. T. Glazebrook, *Physical Optics*; E. Edser, *Light for Students*.

Polder, the name given in the Netherlands to an area of land reclaimed from the sea, a marsh, or a lake by artificial drainage, protected by dikes, and brought under cultivation. There are good examples in the four polders of the Zuider Zee littoral. The polders were for the most part formerly permanently submerged areas. The usual method of procedure in the formation of a polder is to enclose the portion to be reclaimed by an embankment, and construct a channel having its bed sufficiently high to cause a current towards the sea or river. The water is then pumped into this canal by means of pumping apparatus driven by steam or otherwise. See *Netherlands; Zuider Zee*.

Pole, Reginald, English cardinal and statesman, born in Staffordshire 1500, died 1558. He was the son of Sir Richard Pole, Lord Montacute, cousin to Henry VII, by Margaret, daughter of the Duke of Clarence, brother to Edward IV. Educated at Oxford, he had several benefices conferred on him by Henry VIII, with whom he was a great favourite. In 1519 he visited Italy, and fixed his residence at Padua. He returned to England in 1525, but about 1531 lost the favour of Henry by his opposition to the divorce of Queen Catherine. He retired to the Continent for safety, was attainted, and his mother and brother were executed. On the accession of Mary (1553) he returned to England as Papal legate, and on the death of Cranmer became Archbishop of Canterbury, being at the same time elected chancellor of the Universities of Oxford and Cambridge. He died in Lambeth Palace the day after Mary's death. He seems to have been noted for his mildness, generosity, and comparative moderation, in an age when persecution was deemed lawful on all sides.

Pole, the name given to either extremity of the axis round which the earth revolves. The northern one is called the *north pole*, and the southern the *south pole*. Each of these poles is 90° distant from every part of the equator. (See *Geography*.) In astronomy, the name is given to each of the two points in which the axis of the earth is supposed to meet the sphere of the heavens. The stars appear to revolve round the elevated or visible pole. In a wider sense a pole is a point on the surface of any sphere equally distant from every point of the circumference of a great circle of the sphere; or a point 90° distant from the plane of a great circle, and in a line passing perpendicularly through the centre, called the axis. Thus the

zenith and nadir are the *poles* of the horizon. So the *poles* of the ecliptic are two points of the sphere whose distance from the poles of the earth's equator is equal to the obliquity of the ecliptic; they are 90° distant from every part of the ecliptic. *Pole*, in physics, denotes the points of a body at which electric or magnetic forces of opposite qualities are centred, as the poles of a magnet, the north pole of a needle, the poles of a battery.

Polecat, a name common to several species of digitigrade carnivora of the weasel family (Mustelidæ). The common polecat (*Putorius fætidus*) is found in most parts of Europe. Its body is about 17 inches long, and the tail 6 inches. The colour is dark-brown. It is a nocturnal animal, sleeping during the day and searching for its prey at night. It is especially destructive



Polecat (*Putorius fætidus*)

to poultry, rabbits, and game, as pheasants, so that in Britain it is being rapidly exterminated by gamekeepers, farmers, and others. Frogs, toads, newts, and fish are often stored as food by this voracious animal. It has glands secreting a fetid liquor, somewhat like that of the American skunk, which it ejects when irritated or alarmed. The name of 'Foumart' is also applied to the polecat; and its fur, which is imported in large quantities from Northern Europe, is known as that of the 'Fitch'. Its hairs are used in the making of a superior kind of artists' brush.

Polemonia/cææ, a natural order of gamopetalous dicotyledons with a trifid stigma, three-celled fruit, and seeds attached to an axile placenta, the embryo lying in the midst of albumen. They consist for the most part of gay-flowered herbaceous plants, natives of temperate countries, and particularly abundant in the north-western parts of America. They are of no economical importance. Some are cultivated for their beauty, the well-known phlox being one. *Polemonium cæruleum*, known as Greek valerian or Jacob's ladder, is the only British species.

Pole-star, the star α of the constellation

Ursa Minor, situated about 1° from the north celestial pole, round which it apparently describes a small circle. It is of the second magnitude, and is of great use to navigators in the northern hemisphere. Two stars called the pointers, in the constellation Ursa Major (the Great Bear, a portion of which is commonly

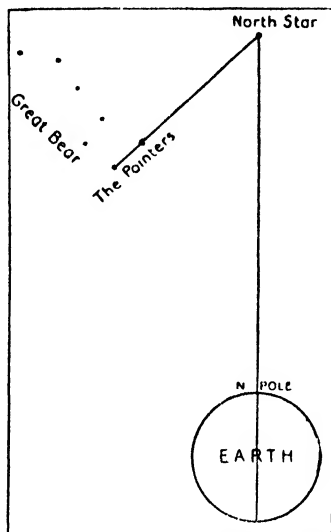


Diagram showing the Position of the North or Pole Star

called the Plough), always point in the direction of the pole-star, and enable it to be found readily.

Pollanite. See *Pyrolusite*.

Pollanthes, a genus of plants belonging to the nat. ord. Amaryllidaceae. They are natives of the East Indies and South America, and in Britain require the aid of artificial heat, and the shelter of frame or greenhouse, to bring them to flower in perfection. The *P. tuberosa* or *tuberosa* is well known for its delicious fragrance. See *Tuberosa*.

Police (po-lēs'), the system instituted by a community to maintain public order, liberty, and the security of life and property. In its most popular acceptance the *police* signifies the administration of the municipal laws and regulations of a city or incorporated town or borough. The primary object of the police system is the prevention of crime and the pursuit of offenders; but it is also subservient to other purposes, such as the suppression of mendicancy, the preservation of order, the removal of obstructions and nuisances, and the enforcing of those local and general laws which relate to the public health, order, safety, and comfort. The term is also applied to the

body of men by which the laws and regulations are enforced. A police force is usually made up partly of men in uniform, and known to everybody, and partly of men in plain clothes, who are known as detectives.

The police system in England, as at present organized, dates from 1829, when the remodelling of the police system of the metropolis led the way to the adoption of a uniform system for the whole country. In 1829 Sir Robert Peel got an Act passed "for improving the police in and near the Metropolis". Several modifications were introduced by subsequent Acts of Parliament, especially by 2 and 3 Vict. caps. xlvii and xciv (1839); and other cities and boroughs from this time forward successively acquired, by separate Acts of Parliament, the necessary powers to enable them to institute and maintain a police force on the model of the metropolitan force. In 1839 and 1840 Acts were passed providing for the appointment of a county constabulary, organized and maintained in accordance with rules prescribed by the Secretary of State for the Home Department. The county magistrates, however, were left the option of taking advantage of these Acts, and accordingly many counties took no steps in the matter. But by 19 and 20 Vict. cap. lxi (1856) it was made compulsory, and there is now a county constabulary force in every county (as well as a borough police), which reports annually to the Secretary of State, the force being under the periodical inspection of officers appointed by the Crown. By the Local Government Act of 1888 the management of the county police is put under the county council and justices jointly, the police of boroughs having a population of less than 20,000 being also put under the county council. The total number of the police in England and Wales is over 56,000. Of these the metropolitan police number over 21,000, forming a distinct body directly under the Home Secretary. The police are supported partly by local assessment, partly by the general revenue of the country. They are not allowed to be members of a trade union, but those below the rank of superintendent may join the Police Federation established by the Police Act, 1919. The employment of women police was commenced in 1920.

Polishing, the process by which the surface of a material is made to assume a perfectly smooth and glossy appearance, usually by friction. The article to be polished must first be made smooth and even. In the case of wood, one of the most common processes is known as French polish (q.v.). With metals, the processes are varied to suit the character of the material and the purpose the polishing is to serve. A process known as 'lapping' is used in polishing

cutting implements, such as razors. This is performed with a revolving wheel made up of segments of wood, with the fibres arranged approximately in radial lines. The wood is covered with an alloy of tin and lead. Other polishing work is performed with leather-covered wheels and fine emery powder. Metal-working of this character is usually finished with crocus. Jewellery is polished with rouge, either on a buff (a revolving pad made up of circular sheets of cloth), or by hand with the use of a rag.

In metallography great care must be taken in the preparation of the specimens cut from the billets. The first process consists of grinding with emery on a revolving wooden wheel. Finer and finer grades of emery are used towards the end, and before using the papers for the last stages they are rubbed against a hard steel surface to remove any coarse particles. The process is completed by rubbing with wet cloths or parchment, covered with jewellers' rouge. Tin-putty, lead siftings, and tripoli are common materials used in the polishing of glass, marble, granite, and other ornamental stones. Furniture-polishes are made of shellac, gums, and a solvent such as spirits of wine, or are water solutions of bees'-wax, white wax, and soap.

Polishing-slate, a grey or yellowish deposit, composed of the siliceous remains of microscopic organisms, found in Bohemia and in Auvergne, and used for polishing glass, marble, and metals.

Politian, or **Poliziano** (po-let-se-a'no), Angelo (Latinized form, *Politianus*), Italian scholar and poet, born 1454, died 1494. The first production which brought him into notice was a Latin poem on the tournament of Giulio de' Medici. He became an ecclesiastic, and acquired the favour of Lorenzo de' Medici, who made him tutor to his children, and presented him with a canonry in the Cathedral of Florence. In 1484 he visited Rome, and after his return to Florence he lectured with distinguished success on the Latin and Greek languages, and likewise on philosophy. He wrote an *Account of the Conspiracy of the Pizza*, a Latin translation of Herodian, and a collection of Greek epigrams, besides Latin odes and epigrams, and a Latin poem entitled *Rusticus*. He also contributed greatly to the correction and illustration of the *Pandects*.

Political Economy. See *Economics*.

Politics. Since its origination by the Greeks the term has become expanded in its meaning. To-day it connotes two things: (1) the science and art of government, i.e. the conduct of man to State, State to man, or State to State; (2) the organization of the people, and the art of influencing public opinion with the view of serving or controlling the State. The second is the more generally accepted interpretation in modern times, with a tendency towards the

cynical view, implying that politics are becoming more and more professional and even sinister. This, however, may be but a phase, inevitable in the development of the distribution of power. Greek philosophers noted three forms of government, or social organization—monarchy, oligarchy, and democracy. The Romans added nothing to these theories, and later, feudalism and the Roman Church were dominant.

With the Renaissance new theories began to be evolved, with steady advancement from the obnoxious principles of Machiavelli, through Grotius and Hobbes to Rousseau. But before then the doctrine of the divine right of kings had been assailed both by the nobles and the people, that is, by the aristocracy and by the democracy, who each, and sometimes in unison—as in the action which led to the foundation of Parliament—made demands for a voice in government. This conflict became continuous, with periods of revolution, civil war, and curtailment of the power of the Church. Every movement saw a deeper significance attached to the ethics of government. It was not merely that power passed little by little from the few to the many, but that the few were made to realize their responsibilities and the necessity of surrendering their privileges, whilst the majority gradually accepted the theories of their advanced advocates that the science of government embraced the whole welfare of the peoples. Royal prerogative gave way to popular liberty with the utmost reluctance. The struggle towards democracy was fitful; the nobles yielded with bad grace; the privileges which appertained to the possession of land are still jealously regarded by the aristocracy; and it cannot be said that all that has been gained by the masses is deemed wise or useful by those who maintain that society falls into two classes, roughly, the rulers and the workers. With the growth of parliamentary institutions as the instruments to secure the power of the people, parties became defined in politics. In England there were the Tories, more generally known now as the Conservatives, who were comprised of the 'upper' classes and their adherents; and the Whigs, who later developed into Liberals, with an advanced element known as the Radicals. The Tory view may be defined as postulating the duty of the class to govern the people (for their good), a version of benevolent despotism; the Whig conception was that the elected representatives were trustees of the nation, with the right to rule according to their discretion; the Radical idea, now fairly generally accepted, was that the people should govern themselves through the House of Commons. The opinion is still held by some that whilst Radicals might originate theories, Tories and Whigs must administer.

In this way parties became organized with the object of controlling Parliament from without, through the electors and the constituents. Politics resolved themselves into party government. The party in the majority became the party in power, forming the Cabinet, and devising and carrying out the programme of legislation; whilst the minority constitutes the Opposition, whose function is to criticize, and resist as well as assist.

Periodically, a coalition is formed by two parties, but there is usually a reversion to party, despite the criticism that the sharp cut leads to abuses in the struggle of the 'outs' to become the 'ins'. Party, however, means organization and discipline; it tends to stabilize opinion and to minimize the evil of the group system, which is irritating and makes for insecurity. With the increase in the number of electors a new party has arisen, the Labour Party, which, in Parliament, is yet in its infancy, and has not completely consolidated and defined itself in the country. It contains advanced elements imbued with some of the newer ideas of politics and theories of the State and Government—socialism, syndicalism, and communism. The struggle against the old forms of authority, as, for instance, the continuance of the House of Lords on the hereditary principle, is growing to such an extent that many Tories admit the need for the reconstitution of the Second Chamber on a more democratic basis.

Politics are thus in a continual state of flux, and with the recognized aim of Parliament being the welfare of the nation, morality now plays an important part in political theory. Politics embrace the whole field of sociology. Woman now has the vote, and the life of the people is controlled and directed from the cradle to the grave, and before and after, for antenatal care of the child by attention to the expectant mother is a part of political science, and duties exacted from the estates of the dead are an integral part of national finance, contributing no small share to the revenue. The control of Parliament, legislation, and local administration from without is increasing. Party organizations and non-party associations, formed to promote and protect specific interests, exert influence and pressure on members of the House of Commons and local councillors, who are continually reminded that they are representatives of those who possess the votes which elect them. Virtually the whole country is organized, and politics have become, often willy-nilly, the daily concern of the whole nation. There are those who hold that members of Parliament are thus tending to become delegates rather than representatives, and that this will become more definitely so

when a Labour Government is returned to power. These criticisms or fears may, however, be said to emanate from reactionaries, who regard parliamentary institutions with suspicion and democracy as an evil. Democracy, realizing this, continues to push forward to assert the sovereign rights of the people.

The argument is, that all matters are the care of the State, that legislation can and must adjust every anomaly and remove all evils, and that in this way the nation benefits. This all-embracing view has given rise to a growing counter-opinion that too much legislation is an evil, subversive of individual effort and private initiative, and, furthermore, that it encourages abuse of the privileges and benefits promoted by the State. The European War not only overthrew monarchies, but brought new ideas into politics. National effort secured unity and a breakdown of social barriers, but this gave way to other class distinctions and bitterness, due to profiteering, the wide distribution of honours—always a subject of political criticism—leading to the formation of a new plutocracy, rousing the enmity of the old aristocracy as well as the scorn of the democracy. The power of wealth being intensified, the resentment of the masses was accentuated into a demand for a new relation between master and man, so that the latter should have a greater share in the product and a voice also in the control of industry. Even before the war the desire for closer international relations was manifest. International Socialist and Labour conferences were held, and out of the peace conferences there grew the League of Nations, the political possibilities of which are illimitable, but as yet problematic.

Polk (pōk), James Knox, President of the United States between the years 1845 and 1849, was born in 1795 in North Carolina, died at Nashville 1849. He studied law, entered Congress as representative of Tennessee in 1825, and was Speaker of the House of Representatives from 1835 to 1838. His advocacy of the annexation of Texas led to his election as President in 1844. The annexation of Texas, the Mexican War, the acquisition of Upper California and New Mexico, and the settlement of the Oregon boundary were the chief events of his term of office.

Polka, a round dance which originated in Bohemia about 1830. The music to it is in $\frac{3}{4}$ time, with the third quaver accented. There are three steps in each bar, the fourth beat being always a rest. Introduced into Western Europe about 1840, the dance soon became very popular.

Pollack (*Gadus pollachius*), a fish of the cod family. The pollack belongs to the same genus as the whiting (*G. merlangus*) and cod (*G.*

morrhua); the members of this genus possessing three dorsal fins and two anals. The lower jaw is longer than the upper jaw, and the tail is forked, but not very deeply. It inhabits the Atlantic Ocean, and is common on all the British coasts, as well as on the shores of Norway. The northern coasts of Britain appear to be those on which these fishes are most abundant. The pollacks are gregarious in habits, and swim in shoals. They bite keenly at either bait or fly, and afford good eating. They are called *Lythe* in Scotland.

Pollan, the 'freshwater herring' (*Coregonus pollan*), a species of fishes belonging to the Salmonidæ. It is an Irish species found in Lough Neagh, and is generally about 9 or 10 inches in length. Related species are found in Lough Erne and the Shannon lakes. There is also a Scottish species (*C. clupeioides*) in Loch Lomond, known as the Powan. See *Vendace*.

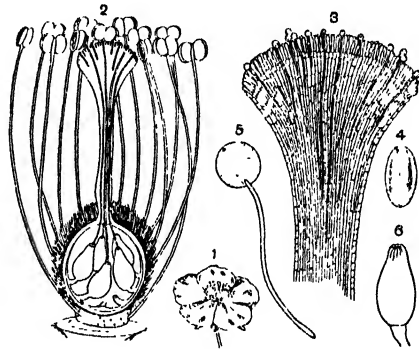
Pollanarrua, the former name of an ancient capital of Ceylon, now called Topare (q.v.).

Pollen, the powdery substance produced in the anthers of Flowering Plants. It consists of numerous minute rounded or ellipsoidal cells (pollen-grains), with fairly thick walls, which are usually ornamented with ridges, spines, or other markings. The contents are dense cytoplasm with reserve-material (oil, starch, &c.) suspended in it, a rounded *vegetative* or *tube nucleus*, and a spindle-shaped *generative nucleus*. Pollen is dispersed either by wind, in which case it is dry and dusty, or by animals (usually insects), when it is moist and sticky. When deposited on the stigma (or placed in a suitable nutrient solution, e.g. 8 to 10 per cent cane-sugar for pollen of wild hyacinth), a pollen-

growth of this pollen-tube; the generative nucleus also passes into the tube and divides into two *male nuclei*, which are the male gametes. Pollen-grains correspond to microspores, being formed in fours from the pollen mother-cells of the anther by a reduction division. See *Heterosporry*.

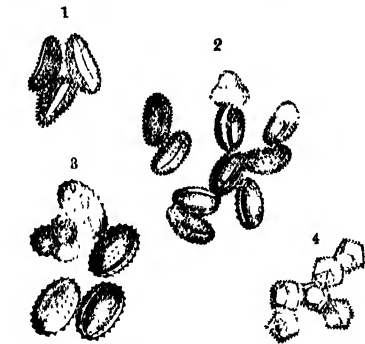
Pollen-protection, a feature in the structure of many flowers, especially in moist climates, where protection of pollen against wetting by rain or dew is secured by a variety of devices, such as infolding of the petals, curving of the flower-stalk, &c. There is a detailed account, with figs., in Kerner and Oliver, *Natural History of Plants*.

Pollination, in Flowering Plants, the transference of pollen from the stamens to the stigma



Pollination

1, Rock-rose. 2, Flower stripped of its sepals and petals, showing stigma and style and ovary in longitudinal section (magnified). 3, Stigma (still further magnified). 4, Dry pollen-grain (very highly magnified). 5, Moistened pollen-grain developing its tube (very highly magnified). 6, An ovule (magnified).



Pollen-grains as seen under the Microscope

1, Water-lily. 2, Mistletoe. 3, Carline-thistle. 4, Dandelion.

grain germinates by emitting a *pollen-tube*, which grows down through the style into the ovary, and finally through the micropyle of an ovule to the ovum. The tube nucleus controls the

of the same (self-pollination) or of another (cross-pollination) flower of the same species; a necessary preliminary to fertilization.

Pollio, Gaius Asinius, a Roman of plebeian family, born 76 B.C., died A.D. 4. He took a prominent part in the Civil War, and accompanied Julius Cæsar to Pharsalia, and then to the African and Spanish Wars. After obtaining the consulship he commanded in Illyria and Dalmatia, and for his victories was honoured with a triumph (39 B.C.). He afterwards devoted most of his time to literary pursuits, but acted both as a Senator and an advocate. His works, consisting of speeches, tragedies, and a history of the Civil War in seventeen books, have all been lost. He was the friend of Virgil, who dedicated to him his fourth *Eclogue*, and of Horace, and founded the first public library in Rome.

Pollock, Sir Frederick, British jurist, was

born in London in 1845, and educated at Eton and at Trinity College, Cambridge, of which he became Fellow in 1868. He was called to the Bar at Lincoln's Inn in 1871, and in 1882-3 he was professor of jurisprudence in University College, London. From 1883 to 1903 he occupied the chair of jurisprudence at Oxford, and from 1884 to 1890 he was professor of common law in the Inns of Court. Among his published works are: *Digest of the Law of Partnership*, *Introduction to the History of the Science of Politics*, and *A First Book of Jurisprudence*. With F. W. Maitland he wrote a *History of English Law before Edward I*.

Pollok, Robert, a Scottish poet, born at Muirhouse, in the parish of Eaglesham, Renfrewshire, 1799, died at Southampton 1827. He is the author of a series of *Tales of the Covenanters*, and a blank verse poem, *The Course of Time*, which in spite of many faults enjoyed a wonderful popularity both in Britain and America.

Poll-tax, a tax levied per head in proportion to the rank or fortune of the individual; a capitation tax. This tax was first levied in England in 1377 and 1380, to defray the expenses of the French War; its collection in 1381 led to the insurrection of Wat Tyler. The hearth-money of the reign of King William III was virtually a poll-tax, and was equally unpopular, though it led to no outbreak.

Pollux. See *Castor and Pollux*.

Pollux, Julius, a Greek sophist and grammarian, born at Naucratis, Egypt, about A.D. 135. He went to Rome during the reign of Marcus Aurelius, who appointed him one of the preceptors of his son Commodus. He wrote several works, all of which have perished except his *Onomasticon*, dedicated to Commodus, and therefore published before 177. This work is of great value in the study of Greek antiquity.

Polo, Gaspar Gil, a Spanish poet, born at Valencia about 1517, died 1572. His reputation was established by his *Diana Enamorada*, a pastoral romance, partly in prose and partly in verse, a continuation of Montemayor's *Diana*, from which Shakespeare took the plot of *The Two Gentlemen of Verona*. Cervantes excepts the *Diana* of Polo from his list (in *Don Quixote*) of works condemned to be burned. It has been translated into French, English, and Latin.

Polo, Marco, Venetian traveller, was born about the year 1254, died probably in Jan., 1324. His father Nicolo was the son of Andrea Polo, a patrician of Venice. In 1271 he accompanied his father and his uncle Matteo on an expedition to China, which the latter had already visited in 1269. After reaching the court of Kúblai, the Great Khan of the Mongols, Marco rapidly learned the language and

customs of the Mongols, and became a favourite with the khan, who employed him on various missions to the neighbouring princes. Soon afterwards he was made Governor of Yang-tchou, in Eastern China, an appointment he held for three years. In 1292 the three Polos accompanied an escort of a Mongolian princess to Persia. After arriving at Tehrân they heard of Kúblai's death, and resolved to return home. They reached Venice in 1295. In the following year Marco Polo took part in the naval battle of Curzola, in which he was taken prisoner. During his captivity he dictated to a fellow-prisoner, Rustichello or Rusticiano of Pisa, an account of all his travels, which was finished in 1298. His book—known as the *Book of Marco Polo*—has gone through numerous editions in the various European languages, but the best is that of Colonel (Sir Henry) Yule, accompanied with a great amount of learned elucidation and illustration. It was originally written in French, but Latin and Italian manuscripts of it are more common.

Polo, a game which has been described as a sort of hockey on horseback, the essential feature being to drive a ball through a goal, the players being mounted on 'polo-ponies'. The term appears to be derived from *pulu*, which is Tibetan for 'a ball', the game being of Oriental origin, probably from Persia, whence it extended into India. It was introduced into this country in 1869 by the 10th Hussars and rapidly became popular, although owing to the expense, principally the maintenance of a number of highly skilled and necessarily expensive ponies, it is restricted to the wealthy classes, chiefly members of the aristocracy and crack cavalry regiments, although abroad, e.g. at Gibraltar, Malta, and in India, it is more within the means of the less affluent.

In this country the clubs of Ranelagh, Roehampton, and Hurlingham (the last named being the principal authority for the game and arbiter of the rules) in London are the chief venues. The most important contests are the Ranelagh Open Cup, the Hurlingham Challenge Cup, the Inter-Regimental Cup, the Oxford and Cambridge match, and an international match between England and America. The first of these international contests was played in New York in 1886; since then there have been seven other contests, the honours having been equally divided.

The rules have been modified from time to time, and even to this day there is no uniformity. The size of the ponies is limited to 14 hands 2 inches. The size of the ground is variable within certain limits, although usually 300 yards long and 200 yards wide. Its boundaries are marked by white boards raised 10

inches from the ground. The goals at the extremities are 8 yards wide. The teams, originally eight a side, are now restricted to four a side. The ball is of willow or alder, painted white, and 3 inches in diameter. The sticks are approximately 4 feet 6 inches in length, with a cross-piece at one end for striking the ball.

The players are usually described as Nos. 1, 2, 3, and 4. No. 1 devotes himself to the back player of the opposing side, and is in the most difficult position of all. No. 2 plays right forward, and is selected for his hitting-power. No. 3 occupies an intermediate position. No. 4, or back, is usually taken by the captain to direct players in front.

The play consists of six periods or *chukkas* (so spelt by the Hurlingham Club) of eight minutes' duration, with three-minute intervals between each, during which ponies are changed. Both player and pony are essential factors in skilful play, and a great deal depends upon the quickness of a pony to answer his rider's command. Roughly speaking, the principles underlying hockey govern the rules of the game; there is no off-side rule, but there are rules providing precautions to avoid dangerous collisions so far as possible. No player may hit the ball when he is dismounted, and in the event of his stick breaking he must gallop to the boundary-line to obtain a fresh one.

Nobody interested in polo should omit to read Rudyard Kipling's short story *The Maltese Cat* (in the volume entitled *The Day's Work*), which is an enthralling and technically accurate description of a match. See *Polo Pony*.

Polonaise (It. *Polacca*), a Polish national dance, which has been imitated, but with much variation, by other nations. The *Polonaise*, in music, is a movement of three crotchets in a bar, characterized by a seeming irregularity of rhythm, produced by the syncopation of the last note in a bar with the first note of the bar following, in the upper part or melody, while the normal time is preserved in the bass.

Polonium, the name given by Mme Curie to the first radio-active substance which she succeeded in separating in her celebrated experiments on uranium minerals in 1898. Its atomic weight is 210, and atomic number 84. Its activity, as measured by the α -rays, is 5000 times that of radium. The activity decays to half its original value in 136 days. In the series of transformations undergone by radium, polonium is the last product but one, being identical with radium F. There are strong reasons for believing that the final product is one of the isotopes of lead, but definite experimental verification that polonium becomes transformed into lead is still wanting. See *Isotopes*; *Radio-activity*; *Radium*.

Polo-pony. The ideal polo-pony stands 14 hands 2 inches high, 'Hurlingham measurement', i.e. a little over the strict measurement of the show-yard. As the thoroughbred is the best exponent of pace, the breeder must ensure that his ponies are as nearly thoroughbred as possible on the sire's side, with sufficient good conformation, pluck, and stamina on the dam's side to ensure worth. In polo, pace naturally enough is indispensable, but the pony must also be broken to stick and ball and to bending, and such training demands good horsemanship, good hands, a little patience, and an infinite amount of perseverance. The value of any polo-pony is dependent solely upon his training and his aptitude for the game, although looks may also be taken into consideration.—Cf. article in *Live Stock of the Farm* (Professor C. Bryner Jones, M.Sc., editor), vol. iii.

Po'lotsk, an ancient town of Russia, in the former government of Vitebsk, at the confluence of the Polotka and Dvina; connected by rail with Vitebsk. The dilapidated castle (Kremlin) was built by Stephen Bathory, King of Poland, in the sixteenth century. There were an upper castle and a lower castle, connected by a bridge. In the remains of the former stands the Greek Catholic cathedral of St. Sophia, built in the eighteenth century on the site of a fifteenth-century foundation. Pop. 32,000.

Polotsk is mentioned in A.D. 862. From 980 it was an independent principality, but fell to the Lithuanians in 1320, and was finally subjugated by them in 1385. Stephen Bathory took Polotsk from the Russians, who, under Ivan the Terrible, had captured it in 1563, and it became definitely Polish in 1582. During the partitions of Poland the town was frequently burned and plundered, and was finally annexed to Russia in 1772. In March, 1918 (European War), it was invested by the Germans.

Polta'va, or **Pultawa**, a former government of Russia, in the Ukraine; area, about 19,265 sq. miles. It consists of an extensive and somewhat monotonous flat, watered by several tributaries of the Dnieper. It was one of the most fertile and best cultivated portions of the Russian Empire. Live-stock and bee-rearing are important branches of the rural economy. Both manufactures and trade are of limited extent. Pop. about 3,900,000. See *Ukraine*.

Poltava, a town of Russia, capital of the government of Poltava, on the Poltavka and Vorskla Rivers at their confluence; served by the Kiev-Kharkov Railway, of which it is a junction. Wool is the great staple of trade. Horses, cattle, and sheep are sold. Poltava contains a monument to Peter the Great, who here defeated Charles XII in 1709. The town fell to the Germans in March, 1918 (European

War), and was taken by General Denikin during the 'White' campaign of 1919.

Polyandry (Gr. *polys*, many, and *aner*, *andros*, a man), a form of marriage in which one woman has more than one husband at a time. There are two types of polyandry, the fraternal form (in which the husbands are brothers), existing among the Tibetans, and the non-fraternal, among the Nayars of India. Polyandry prevailed among the Celts of Britain in Cæsar's time, and occurs yet among the Eskimo, the Aleutians, some tribes of American Indians, and in the South Seas. The practice is believed to have had its origin in unfertile regions in an endeavour to check the undue pressure of population on the means of subsistence. The antithesis of polyandry is polygyny, or plurality of wives.

Polyanthus, a beautiful and favourite variety of the common cowslip (*Primula veris*), a native of most parts of Europe. The leaves are obovate, oblong, toothed, rugose, and villous beneath. The flowers are in umbels on a scape or flower-stalk 3 to 6 inches or more in length. Plants may be propagated from seeds, but they may also be readily increased by division.

Polybius, Greek historian, was born about 204 B.C., and died 122 B.C. His father, Lyncortas, was one of the leaders of the Achæan League, and an intimate friend of Philopœmen. At the age of twenty-four he entered into the military and political service of the League. After the subjugation of Perseus, King of Macedonia, by the Romans (168 B.C.) Polybius found himself among the thousand Achæans summoned to Rome to explain before the Senate why the League had not aided the Roman army in Macedonia. While in Italy he formed an intimate friendship with L. Æmilius Paullus and his two sons Scipio and Fabius. He accompanied Scipio (P. Cornelius Scipio Africanus the Younger) on his African campaign, and was an eyewitness of the destruction of Carthage. He returned to Greece in 146, just after the fall of Corinth, and exerted himself successfully to obtain moderate terms from the Romans for his countrymen. His principal work is his history of Rome, from 220 to 146 B.C. It was written in forty books, but only the first five and fairly considerable fragments of the others are extant.

Polybius has almost all the qualities which go to make a good historian, except brilliance and an attractive style. He spared no trouble in making his researches. Not only did he ransack the public archives in many places for documentary records, but he undertook many journeys solely with the view of making himself acquainted with the terrain of the battles he was describing. He was studiously impartial,

and was skilful in weighing contradictory evidence. Many of the events he related took place in his own lifetime, and some in his own presence. In spite of all these advantages he is little read; indeed it is hardly too much to say he is never read for pleasure, but purely on account of the invaluable information which he conveys. He is a classic illustration of the rule that literary style cannot be neglected with impunity.—BIBLIOGRAPHY: W. W. Capes, *The History of the Achæan League*; J. B. Bury, *Ancient Greek Historians*.

Polycarp, apostolic Father and one of the early Christian martyrs. According to Irenæus, he was a disciple of the Apostle John, and was born probably in Smyrna about A.D. 69 or 70; martyred 155 or 156. According to a legendary fragment ascribed to a writer named Pionius, he was consecrated bishop of his native city by St. John. During the persecution under Marcus Aurelius, Polycarp was seized and brought before the Roman proconsul at Smyrna. Having refused to renounce his faith, he was condemned to the flames. He wrote several letters, which were current in the early Church, but have all perished except one addressed to the Philippians, which appears to have been written about 115, and is valuable for its quotations from the apostolic writings.

Polyclitus of Sicyon, Greek sculptor and architect, who flourished about 452–412 B.C., and stood at the head of the Argive school. He excelled in the representation of athletic types, and reduced the proportions of the male human form to a rule or canon, exemplified in his *Doryphorus* (Spear-bearer), of which a copy is at Naples. Other important works were: *Diadumenos* (copy in British Museum), *An Amazon* (copy in Berlin), and a great chryselephantine (gold and ivory) statue of Hera. He also distinguished himself as an architect.

Polycratês, tyrant of Samos during the time of the elder Cyrus. He made himself master of the island by violence, and, having secured absolute sway, seized upon several of the neighbouring islands and some towns upon the mainland. The story of his friendship with Amasis, King of Egypt, and the latter's alarm at Polycratês' good fortune, is told by Herodotus. At the advice of Amasis, the tyrant cast his signet-ring, the possession which he valued most, into the sea, but the next day it was found in the inside of a big fish which a fisherman had brought to Polycratês as a gift. In 522 B.C. the Persian satrap Oroctes treacherously invited Polycratês to his palace, and there crucified him. Polycratês seems to have had much taste for learning and the arts, and greatly promoted the refinement of the Samians.

Polyembryony, in botany, a phenomenon

occurring, sometimes regularly and sometimes abnormally, in the development of the ovules of Flowering Plants, consisting in the existence of two or more embryos in the same seed; frequent in the orange.

Polyg'ala, a genus of plants of the nat. ord. Polygalacææ. The species abound in milky juice, and are found in most parts of the world. The root of *P. senega* (senega or seneca root or Virginian snake-root) is a stimulating diuretic, useful in pneumonia, asthma, and rheumatism. *P. vulgaris*, or milkwort, is a British plant, common in dry pastures.

Polygala'ceæ, a natural order of herbs or shrubs, with alternate, exstipulate, simple leaves; irregular hermaphrodite flowers; diadelphous or monadelphous stamens; anthers opening at the apex by a pore or chink. Nearly half the species are comprised in the genus *Polygala*, and are very generally distributed. The plants of this order are mostly bitter, and acrid or astringent.

Polyg'amy (Gr. *polys*, many, *gamos*, marriage), a term usually applied to that form of marriage in which a man has more than one wife. The term, however, includes as well the custom of one woman having several husbands, its antithesis being *monogamy*. In ancient times polygamy was practised by all the Eastern nations, and was sanctioned or at least tolerated by their religions. It was permitted to some extent among the Greeks, but entirely disappeared with the later development of Greek civilization. To the ancient Romans and Germanic races it was unknown. It prevailed among the Jewish patriarchs both before and under the Mosaic law, but in the New Testament we meet with no trace of it. Polygamy has never been tolerated among Christians, although the New Testament contains no injunction against it. It is, however, practised by the Mahomedans. A statute of Edward I treated polygamy as a capital crime.

Polyg'lot (Gr. *polys*, many, and *glōtta*, language) is more particularly used to denote a copy of the Holy Scriptures in which two, three, or more translations are given, with or without the original. The first great work of the sort is the *Complutensian Polyg'lot*, prepared under the direction of Cardinal Ximenes, and splendidly printed (1514-7), in six folio volumes, at Alcalá de Henares, called in Latin *Complutum*, whence the name of the work. It contains the Hebrew text of the Old Testament, with the *Vulgate*, the *Septuagint*, with an interlinear Latin version, and a Chaldee paraphrase (which is also accompanied by a Latin translation). Another celebrated *Polyg'lot* is that of Antwerp, called the *Royal Bible* because Philip II of Spain bore part of the cost of publication. It was conducted

by the learned Spanish theologian Benedict Arias Montanus, assisted by other scholars. It appeared at Antwerp in eight folio volumes (1569-72). The *Paris Polyg'lot* appeared in 1645, in ten folio volumes. The *London* or *Walton's Polyg'lot*, in ten languages, appeared in six folio volumes, with two supplementary volumes (London, 1654-7). It was conducted under the care of Bryan Walton, afterwards Bishop of Chester, and contains all that is in the *Paris Polyg'lot*, but with many additions and improvements. It contains the original text according to several copies, with an Ethiopic and a Persian translation, and the Latin versions of each. *Bagster's Polyg'lot* (folio, London, 1831) contains the entire Bible in Hebrew, Greek, English, Latin, French, Italian, Spanish, and German, with a Syriac version of the New Testament in addition.

Polygno'tus, Greek painter, flourished from 450 to 410 B.C. He was a native of the Island of Thasos, and was instructed in his art by his father Aglaophon. Cimon, the rival of Pericles, brought him to Athens and employed him to decorate the Stoa Porcile, or painted portico at Athens. His works were probably on wood. Polygnotus is represented as being the first who made painting independent of sculpture.

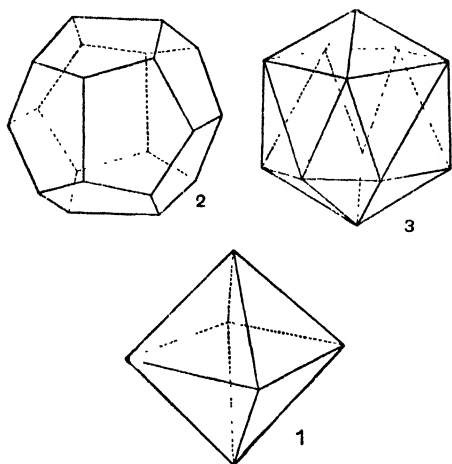
Polygona'ceæ, a natural order of apetalous dicotyledons, with trigonal fruit, and usually with stipules united into a tube or ocrea, through which the stem passes. They have astringent and acid properties; some are purgative, and a few are acrid. Among the best-known species are rhubarb, the docks, and the sorrels. See *Polygonum*.

Polyg'onum, a genus of plants, nat. ord. Polygonacææ. They are found in the temperate regions of Europe, Africa, North America, and Asia. They are herbaceous, rarely shrubby plants, with alternate stipulate or exstipulate leaves, and spikes of small pink flowers. Several British species are known by the name of persicarias. See *Bistort*; *Buckwheat*; *Knot-grass*.

Polygyn'ia, one of the orders in the fifth, sixth, twelfth, and thirteenth classes of the Linnæan system, comprehending those plants which have flowers with many pistils, or in which the pistils or styles are more than twelve in number.

Polyhe'dron, a solid figure contained by plane faces. It is said to be convex if it lies entirely on one side of each of its faces. In a regular convex polyhedron, sometimes called a Platonic solid, the faces are equal regular polygons, and the solid angles are equal. The last proposition of the thirteenth book of Euclid's *Elements* shows that there cannot be more than five of these regular polyhedra. The five are: (1) the tetrahedron, formed by 4 equilateral triangles; (2) the cube, by 6 squares; (3) the

octahedron, by 8 equilateral triangles; (4) the dodecahedron, by 12 pentagons; (5) the icosahedron, by 20 equilateral triangles. It may easily be verified from the figures that in each case the sum of the number of faces and the

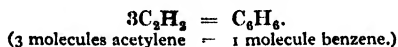


Polyhedra

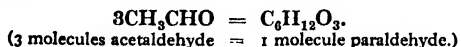
1, Octahedron. 2, Dodecahedron. 3, Icosahedron.

number of vertices is greater by two than the number of edges, a theorem usually ascribed to Euler.

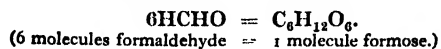
Polym'erism, or **Polymerization**, in chemistry, the formation of new molecules by union of several into one. Thus acetylene, if heated in a sealed tube, may be polymerized to benzene,



Acetaldehyde may be polymerized to paraldehyde,



The sugar-like body *formose* may be formed by the polymerization of formaldehyde,



Many substances polymerize spontaneously, others are polymerized by heat, or the change may be brought about by the addition of a chemical reagent.

Polymerization entirely changes the chemical properties of the substance, the atoms in the molecule becoming rearranged. Thus benzene has properties totally different from acetylene; paraldehyde has none of the properties of acetaldehyde nor of the aldehydes generally.

Polymor'phism, the property possessed by

certain bodies of crystallizing in two or more forms not derivable one from the other in accordance with the Law of Rationality that governs natural crystal forms. Thus mercuric iodide separates from a solution in tables belonging to the tetragonal system; if these crystals are heated, they sublime and condense in forms belonging to the orthorhombic system. The aluminium silicate Al_2SiO_5 crystallizes in three distinct series of crystallographic forms, thus furnishing three mineral species, andalusite, sillimanite, and kyanite. See *Crystal*.

Polyne'sia (Gr. *polys*, many, *nēsos*, island), a great division of Oceania, lying east of Melanesia and Micronesia. The principal island-groups are: Hawaii, the Phoenix, Marquesas, Paumotu, Society, Ellice, Samoa, Union, Manihiki, and Tonga groups. See map under *Oceania*; and articles on separate island-groups.

Polynesian People and Language, the names given to the native populations (and their speech) of New Zealand (Maori), Tonga, Samoa, Tahiti, Marquesas, Hawaii, and the eastern parts of the Fiji group; in other words, the earliest inhabitants of those islands in the Pacific Ocean lying east of a line drawn through the Fiji Islands from Hawaii to New Zealand. The islands to the west of this line belong mainly to the Melanesian or to the Papuan peoples, or a mixture of these, the one with the other or with Polynesians, Indonesians, or Malays. The Polynesians are a mixed population, the chief racial ingredients of which consist of an admixture of peoples akin to the so-called Mediterranean or Brown race of Western Asia and Europe, and the southern branch of the Armenoid or Alpine race, who more than fifty centuries ago had already made their way to the shores of the Eastern Mediterranean and the Persian Gulf. These littoral populations acquired from the Egyptians the art of boat-building and the practical knowledge of navigation, and several millennia ago made their way by sea to India, where they were the means of communicating to their kinsmen of the Brown race in Southern India the germs of Western culture. In course of time these ancient mariners pushed farther east to Burnah and Malaya, to Indonesia and Melanesia, thence to the more easterly islands of the Pacific Ocean, to which they gave their earliest human inhabitants, with their language and culture. In every successive stage of their wanderings new racial ingredients were added to the original Brown-Alpine mixture, in India, Indonesia, and Melanesia, so that the Polynesian, in spite of certain obvious European resemblances, reveals very definite traits of Malay and Melanesian influence. In some of the Polynesian islands, in fact, the Melanesian strain may be most obtrusive, as

in Easter Island, even though the language and culture are unmistakably Polynesian.

From their history it is not surprising to find that the Polynesians were the most expert mariners of all primitive peoples, skilfully navigating large double canoes hundreds or even thousands of miles. They served as the bond of union and the means of maintaining a remarkably uniform culture and speech throughout the far-flung islands of their vast domain. By means of these ships and sailors, not only were Western culture and the essentially Egyptian art of navigation originally introduced into Polynesia, but also for many centuries afterwards the influence of later developments in the art and practice of civilization continued to be introduced into Polynesia, and in fact to be transmitted right across the Pacific Ocean to Central America and Peru, where the germs of Old World culture were planted, probably from about 300 B.C. to A.D. 1200, but mainly between A.D. 300 and A.D. 700.

One of the many elements that establish the proof of the origin of the Polynesian people and their culture is afforded by their language. The remarkable uniformity of the spoken tongue, and the traditions which are preserved by its means throughout the vast expanse of the Pacific, is a striking testimony of the perfection of the process of linking up all these scattered islands by sea-going ships. In spite of the marked contrast between the European-like people of Polynesia and the negro-like inhabitants of Melanesia, there is a great deal in common between their languages, not only in vocabulary, but also in the more fundamental features of grammatical structure and phonetic character; and when we go farther west to Indonesia, we find still more interesting linguistic resemblances, which enable us to visualize the geographical route taken by the ancestral Polynesian wanderers. The brilliant researches of the Austrian philologist Father Schmidt (see especially *Bull. de l'école française d'extrême orient*, 1907, page 213) have revealed a definite kinship between the languages spoken in Polynesia, Melanesia, and Indonesia (which he groups together as the Austronesian tongue), and those of the people of South-Eastern Asia known as the Mon-Khmer languages, and of certain peoples of Assam and India, such as the Mundas and Santhals, which Schmidt calls the Austro-Asiatic tongues. This affords the most definite evidence of the derivation of the Polynesian language from Southern India via Indonesia and Melanesia. But ethnological research, and especially the investigations carried out by the late Dr. Rivers and W. J. Perry, have revealed in the social organization, the customs, and beliefs very definite corroboration of this

general conclusion, as well as more precise information as to a series of waves of Western culture that passed into Polynesia and carried there such distinctively Egyptian practices as mummification, megalithic building, sun-worship, the dual organization of society, and a variety of other equally characteristic elements of the most primitive form of civilization known to us.

The researches of W. J. Perry have demonstrated conclusively that the chief factor in determining the movements of the original Polynesians toward the islands after which they are named was the search for pearls and pearl-shell. Wherever such shells were abundant the wandering sailors settled down to exploit the beds, and incidentally they planted there characteristic social customs and religious beliefs, arts and crafts, which have survived until the present day to reveal the places of the longest sojourn of the culture-bearers who also transmitted the civilization of the Old World to America. For fuller information concerning the people, their customs, beliefs, and history, the reader should consult such works as those enumerated below.—BIBLIOGRAPHY: W. H. R. Rivers, *The History of Melanesian Society*; G. Elliot Smith, *The Migration of Early Culture*; S. Percy Smith, *Hawaiki: the Original Home of the Maori*; W. Churchill, *The Polynesian Wanderings*; A. Krämer, *Die Samoa-Inseln*; G. Brown, *Melanesians and Polynesians*; H. Mager, *Le Monde polynésien*; A. H. Keane, *Man, Past and Present*; Sir G. Grey, *Polynesian Mythology*.

Polyp, or **Polype**, a term which has been very variously and indiscriminately applied to different animals. It has thus been used to designate any animal of low organization, such as the sea-anemones, corals, and their allies; or it has been employed to indicate animals which, like the coelenterate zoophytes or Hydrozoa, and the Polyzoa, bear a close resemblance to plants. It is now generally applied to any single member of the class Anthozoa, represented by the sea-anemones, corals, and the like; or any member (or zooid) of a compound organism belonging to that class. The term *polypide* is employed to designate each member or zooid of the compound forms included in the Polyzoa. The name *polypidom* applies to the entire outer framework or skeleton of a compound form such as a hydrozoan zoophyte. The word *polypite* refers to each separate zooid or member of a compound zoophyte or hydrozoon. The *polypary* of a hydrozoon specially refers to the horny or chitinous covering secreted by the Hydrozoa.

Polypetalous Flowers, those in which the petals are quite separate from one another, a condition characteristic of a large section of dicotyledons, including the Ranunculaceæ, Cru-

ciferæ, Caryophyllaceæ, Rosaceæ, Leguminosæ, Umbelliferæ, &c. Opposed to gamopetalous flowers, in which the petals are more or less coherent.

Polyphe'mus, in Greek mythology, the most famous of the Cyclops, who is described as a cannibal giant with one eye in his forehead, living alone in a cave of Mount Ætna and feeding his flocks on that mountain. Odysseus and his companions having been driven upon the shore by a storm, unwarily took refuge in his cave, and Polyphemus killed and ate four of the strangers. Odysseus, however, intoxicated the monster with wine, and as soon as he fell asleep bored out his one eye with the blazing end of a stake. He then escaped from the cave with his companions. Polyphemus was the despised lover of the nymph Galatea.

Polypodlaceæ, the largest family of Leptosporangiate Ferns, probably not a natural group, but composed of the most advanced members of several series derived from the more primitive families. Most of the species are herbaceous ferns with relatively small creeping stems and large pinnately branched leaves, but many depart from this type in various ways. The family includes most of the more familiar ferns, such as bracken, male-fern, hart's-tongue, hard-fern, maiden-hair, polypody, &c.

Polyp'orus, a genus of Basidiomycetous Fungi, type of the family Polyporineæ (shelf- or bracket-fungi). The *P. destructor* is one of the pests of wooden constructions, producing what is sometimes termed *dry-rot*, although the true dry-rot is a different plant (*Merulius lacrymans*). *P. squamosus* kills a variety of trees, and *P. betulinus* is a common parasite on the birch.

Polyp'terus (Bichir), a genus of fishes inhabiting the Nile, and also the rivers of tropical Africa that flow into the Atlantic. Except the *reed-fish* (q.v.), they are the only surviving members of the Crossopterygii, a very ancient order of fishes dating from the Devonian, and the type of a special family, the Polypteridæ. Their most singular characteristic is the structure of the dorsal fin, which instead of being continuous is separated into twelve or sixteen strong spines distributed along the back, each bordered behind by a small soft fin. In the young there is an external gill. The *Polypterus bichir* attains to a length of 4 feet.

Polypus, or **Polyp**, in medicine, is a pedunculated tumour found in various parts of the body, especially in the nose, ear, rectum, and uterus. Nasal polypi are frequent, and their effect varies from a slight difficulty in breathing to complete obstruction of the affected nostril. Polypi of the uterine wall are also common, and may be either hard or soft. They may

attain to a considerable size, and should be dealt with surgically, as they may slough or become malignant.

Polysiphonia, a large genus of Red Algaæ, with numerous British species, one of the most abundant being *P. fastigiata*, which always grows epiphytically on the large wrack *Ascophyllum nodosum*. The life-history of *P. violacea* has been fully worked out; there are three sets of individuals, viz. male, bearing antheridia; female, bearing carpogonia; and neuter, bearing asexual spores (tetraspores). The fertilized ovum of a carpogonium gives rise, by a complex series of divisions, to carpospores, which on germination grow into neuter plants; whereas the tetraspores give rise to male and female individuals. There is therefore here an alternation of generations, comparable to that of a fern, except that the gametophyte (male and female plants) and sporophyte (neuter plants) generations are identical in form. The nuclear cycle is normal, duplications of chromosomes taking place at the fertilization of the ovum, reduction of chromosomes at the formation of tetraspores. See *Generations, Alternation of*.

Polytechnic Institutions. The first institution of this character was founded by John Anderson, professor of natural philosophy in Glasgow, who left the whole of his personal property with some trifling exceptions "to the public for the good of mankind and the improvement of science, in an institution to be denominated Anderson's University". James Watt owed much to the inspiration of John Anderson, the repair of whose model of a Newcomen engine was the engineer's introduction to the steam-engine. The college was established in 1796 with a charter from the magistrates of the city, and was subsequently incorporated as Anderson's College under an Act of Parliament of 1877, and with other similar institutions in later years became The Royal Technical College. Dr. George Birkbeck was appointed to the chair of natural philosophy and chemistry in 1799, and Mechanics' Institutions owe their origin to the successful classes which he started in the following year. He gave up this post in 1804, and started practice as a physician in London. In 1823, when the classes in Glasgow had grown to such dimensions as to warrant the establishment of the Glasgow Mechanics' Institution, an article in *The Mechanics' Magazine* suggested a similar foundation in London. Dr. Birkbeck took up the suggestion, provided money to build a lecture-room, and carried the scheme to success in spite of the ridicule of critics and the many quarrels of the governing body. Besides the institution bearing Dr. Birkbeck's name, there were one or two early ventures in London, notably The Adelaide Gallery,

called after the queen of William IV, and the institution known to-day as Regent Street Polytechnic. These were little more than museums of scientific instruments where occasionally lectures were given. The second named is popularly associated with 'Professor' Pepper, the author of *The Boys' Playbook of Science* and "Pepper's Ghost" (see *Optical Illusions*). Both these institutions failed, and the Regent Street building was for long disused, until Quintin Hogg purchased it in 1880 and started an evangelistic institute, at which classes of various kinds were held, which gradually developed into the Polytechnic of to-day. The People's Palace owes its origin to the suggestions for improved facilities for education and social intercourse among working-men contained in Sir Walter Besant's novel *All Sorts and Conditions of Men*. The London polytechnics have been largely supported by the wealthy city guilds, and many of them have successful technical and science classes for day students, and some are 'schools' of the London University.

Polythalamia, a group of Foraminifera occupying compound chambered cells of minute size. In some instances each cell of the common shell presents only one external opening, but more commonly it is punctured with numerous minute pores or foramina, through which the animal can protrude filaments. Their remains constitute the bulk of the chalk and tertiary limestone. See *Foraminifera*.

Polytheism (Gr. *polys*, many, *theos*, god), the belief in, and worship of, a plurality of gods; opposed to monotheism, the belief in, and worship of, one god. It is still a matter of debate whether polytheism is a primary form of human belief or a degeneration from an original monotheistic idea. It is argued, on the one hand, that the sense of personal dependence, the feeling that there was an undefined power, a mysterious *something* around and above him, did not primarily present itself to the mind of man except under a form of unity. His earliest religion would therefore be of a monotheistic character. Those who affirm that polytheism was a primary form of religious belief argue that man, ignorant of the nature of his own life, and of the nature, origin, and properties of other objects, could at first only attribute vaguely to all visible things the same kind of conscious existence as that which belonged to himself. Thus the sun, moon, and stars would all be living beings; and as affecting the conditions of men they would be loved or feared. Polytheism existed among the ancient Hebrews, and in the religions of Assyria and Babylonia, Egypt, Greece, and Rome.—Cf. G. F. Moore, *History of Religions*.

Polytrichum, a genus of Mosses, with several British species, of which *P. commune* is abundant

in woods and on moors. The plants are large, and have a relatively complicated internal structure, with rudimentary vascular bundles, &c.; the leaves roll up in dry air, like those of many grasses.

Polyzo'a, or **Bryozoa** (Gr. *polys*, many, *zōon*, animal), a phylum of invertebrate animals, generally known by the popular names of 'sea-mosses' and 'sea-mats'. They are usually compound, forming associated growths or colonies of animals produced by gemmation from a single original individual, and inhabit a *polyzoarium* or aggregate of cells, corresponding to the polypidom of the composite hydroids.



Polyzoa

Small colony of *Lophopus crystallinus*, showing some individuals fully extended, and others in different states of retraction (enlarged).

The polypide, or individual polyzoan, lives in a separate cell or chamber, has a distinct alimentary canal suspended freely in a body cavity, and the reproductive organs contained within the body. The body is enclosed in a double-walled sac, the outer layer (*ectocyst*) of which is chitinous or calcareous, and the inner (*endocyst*) a delicate membranous layer. On the ectocyst are seen certain peculiar processes called 'bird's-head processes', or *avicularia*, from their shape, the use of which is unknown. The mouth-opening at the upper part of each cell is surrounded by a circle of hollow ciliated tentacles, which perform the function of respiration, and are supported on the *lophophore*; and the mouth may be overhung by a sort of valve called the *epistome*. All the Polyzoa are hermaphrodite. In many cases there are *ovicells* or sacs into which the fertilized ova pass. From these proceed free-swimming ciliated embryos which develop into polypides. Continuous gemmation exists in all. The Polyzoa are classed into two groups: Ectoprocta and Entoprocta. The Ectoprocta are divided into two orders of Phylactolamata, with a crescentic lophophore and an epistome; and

Gymnolēmata, with a circular lophophore and no epistome. One of the Entoprocta, *Loxosoma*, is the only non-colonial member of the phylum. They are all aquatic in their habits, the marine Polyzoa being common to all seas, but the freshwater genera are mostly confined to the north temperate zone. They are sometimes confounded with the hydroid zoophytes (see *Hydrozoa*), but are much higher in the scale. An old name for them is *corallines*, and their fossil remains largely make up the Coralline Crag, a subdivision of the Pliocene strata.

Poma'ceæ, or **Po'meæ**, a division of the nat. ord. Rosaceæ, to which the apple, pear, quince, and medlar belong. It differs from Rosaceæ proper in having an inferior ovary. The fruit is always a *pome*, with a crustaceous core or bony stones.

Pomegranate (pom'gra-nāt; *Punica granātum*, allied to Myrtaceæ), a dense shrub, from 8 to 20 feet high, supposed to have belonged originally to the north of Africa, and subsequently introduced into Italy. It was called by the Romans *malum Punicum*, or Carthaginian apple. The leaves are opposite, lanceolate, entire, and smooth; the flowers are large and of a brilliant red; the fruit is as large as an orange, having a hard rind filled with a soft pulp and numerous red seeds. The pulp is more or less acid and slightly astringent. The pomegranate is extensively cultivated throughout Southern Europe, and sometimes attains a great size. Another species (*P. nana*) inhabits the West Indies and Guiana.

Pom'elo (*Citrus Pompelmoos*), also known as *Pompelo* and *Pompelmoose*, a plant closely allied to and resembling the orange and shaddock, and sometimes regarded as merely a variety of the latter. Its fruit is sometimes called the *forbidden fruit*. See *Grape-fruit*.

Pomera'nia (Ger. *Pommern*), a maritime district of Prussia, bounded by the Baltic, Mecklenburg, Brandenburg, and Poland; area, 11,654 sq. miles. The coast is low and sandy and lined by numerous lagoons. The chief islands along the coast are Rügen, Usedom, and Wollin. The interior is flat and in parts marshy, and is remarkable for the number of its lakes. The principal rivers are the Oder, Persante, and Stolpe. Flax, hemp, tobacco, and cereals are raised, and some sheep are bred. Herring-, eel-, and lamprey-fisheries are extensive. A considerable general and transit trade is carried on. The centre of trade is Stettin, which ranks as one of the chief commercial cities of Prussia. Pomerania is divided into the districts of Stralsund, Stettin, and Köslin.

Pomerania appears to have been originally inhabited by Goths, Vandals, and Slavs. The first mention of it in history is in 1140. It long

remained an independent duchy, and in 1637, on the extinction of the ducal family, it was annexed to Sweden. On the death of Charles XII it was ceded to the electoral House of Brandenburg, with the exception of a part which subsequently was also obtained by Prussia. Pop. (1910), 1,718,860; (1919), 1,787,193 (or 153·4 per square mile).

Pomo'na, in Roman mythology, the goddess of fruit, and wife of Vertumnus. At Rome she was usually represented with a basket of fruit, or with fruit in her bosom.

Pomo'na, or **Mainland**, the central and largest of the Orkney Islands, Scotland; area, 150 sq. miles; pop. (1921), 8775. It is extremely irregular in shape, but is roughly divided into two unequal portions by Kirkwall Bay and Scapa Flow (q.v.). On the western side the coast is practically unbroken, but on the east and south it is deeply indented and provides several good harbours. The surface is covered in great part by moor and heath, but good pasture is also to be found, and in the valleys peat-mosses intermingle with stretches of productive soil. The principal towns are Kirkwall (the Orcadian capital) and Stromness. See *Orkney Islands*.

Pompadour (pon-pā-dôr), Jeanne Antoinette Poisson, Marquise de, mistress of Louis XV, was born in 1721, and died at Versailles in the year 1764. She was of obscure parents bearing the name of Poisson, but Lenormant de Tournehem, a rich farmer-general, was supposed to have been her father. In 1741 she married her cousin, Lenormant d'Étioles. A few years later she succeeded in attracting the attention of the king, and soon entirely engrossed his favour. In 1745 she appeared at court as the Marquise de Pompadour. Here she at first posed as the patroness of learning and the arts, but with the decay of her charms she devoted her attention to politics. For almost twenty years she played a predominant part in all State affairs. Her favourites filled the most important offices, and it was through her influence that France ranged herself on the side of her hereditary enemy, Austria, in the Seven Years' War.—Cf. P. de Nolhac, *Louis XV et Mme de Pompadour*.

Pompeii (pom-pā'yē), an ancient town of Italy, in Campania, near the Bay of Naples, about 12 miles south-east of the city of that name, and at the base of Mount Vesuvius on its southern side. Before the close of the Republic, and under the early emperors, Pompeii became a favourite retreat of wealthy Romans. In A.D. 63 a fearful earthquake occurred, which destroyed a great part of the town. The work of rebuilding was soon commenced, and the new town had a population of some 80,000 when it was overtaken by another catastrophe

on 24th Aug., A.D. 79. This consisted in an eruption of Mount Vesuvius, which suddenly belched forth tremendous showers of ashes, and white-hot lava, &c., so as to overwhelm the city for a considerable depth. The present superincumbent mass is about 20 feet in thickness. A portion of this was formed by subsequent eruptions, but the town had been buried by the first catastrophe and entirely lost to view. Pompeii was consigned to oblivion during the Middle Ages, and it was not until 1748, when a peasant in sinking a well discovered a painted chamber with statues and other objects of antiquity, that anything like a real interest in the locality was excited. Excavations were now prosecuted, and in 1755 the amphitheatre, theatre, and other parts were cleared out. Under the Bourbons the excavations were carried out on a very unsatisfactory plan. Statues and articles of value alone were extricated, whilst the buildings were suffered to fall into decay or covered up again. To the short reign of Murat (1808–15) we are indebted for the excavation of the Forum, the town walls, the Street of Tombs, and many private houses. Subsequently the Government of Victor Emmanuel assigned £2500 annually for the prosecution of the excavations, and a regular plan has been adopted, according to which the ruins are systematically explored and carefully preserved. The town is built in the form of an irregular oval extending from east to west. The circumference of the walls amounts to 2925 yards. The area within the walls is estimated at 160 acres; greatest length, $\frac{3}{4}$ mile; greatest breadth, $\frac{1}{2}$ mile. There are eight gates. The streets are straight and narrow and paved with large polygonal blocks of lava. The houses are usually constructed of concrete; occasionally they are brick. Numerous staircases prove that the houses were of two or three stories. The ground floor of the larger houses was generally occupied by shops. Most of the larger houses are entered from the street by a narrow passage (*vestibulum*) leading to an internal hall (*atrium*), which provided the surrounding chambers with light and was the medium of communication; beyond the latter is another large public apartment termed the *tablinum*. The other portion of the house comprised the private rooms of the family. All the apartments are small. The shops were small and all of one character, having the business part in front and one or two small chambers behind, with a single large opening serving for both door and window. The chief public buildings are the so-called Temple of Jupiter, the Temple of Venus, the Basilica, the Temple of Mercury, the Curia, and the Pantheon or Temple of Augustus. There are several interesting private buildings scattered through the town, including

the villa of Diomedes, the house of Sallust, and the house of Marcus Lucretius. The Museum of Naples owes many of its most interesting features to the antiquities excavated in Pompeii. —Cf. J. F. Horne, *Buried Cities of Vesuvius: Herculaneum and Pompeii*.

Pompey, in full Gnaeus Pompeius Magnus, Roman general and triumvir, born 106 B.C., was the son of Gnaeus Pompeius Strabo, an able general. In 89 B.C. he served with distinction under his father in the war against the Italian allies. In the struggle between Marius and Sulla, Pompey raised three legions to aid the latter, and regained all the territories of Africa which had forsaken the interest of Sulla. This success excited the jealousy of Sulla, who recalled him to Rome. On his return Sulla greeted him with the surname of Magnus (Great). Pompey demanded a triumph, to which Sulla reluctantly consented. He entered Rome in triumph in Sept., 81, and was the first Roman permitted to do so without possessing a higher dignity than that of equestrian rank. After the death of Sulla, Pompey put an end to the war which the revolt of Sertorius in Spain had occasioned, and in 71 obtained a second triumph. In this year, although not of legal age and without official experience, he was elected consul with Crassus. In 67 he cleared the Mediterranean of pirates, and destroyed their strongholds on the coast of Cilicia. In the four years 65–62 he conquered Mithridates, Tigranes, and Antiochus, King of Syria. At the same time he subdued the Jews and took Jerusalem by storm. He returned to Italy in 62 and disbanded his army, but did not enter Rome until the following year, when he was honoured with a third triumph. Pompey, in order to strengthen his position, united his interest with that of Cæsar and Crassus and thus formed the first triumvirate. This agreement was concluded by the marriage of Pompey with Cæsar's daughter Julia; but the powerful confederacy was soon broken. During Cæsar's absence in Gaul, Pompey ingratiated himself with the Senate, was appointed sole consul, and the most important State offices were filled with Cæsar's enemies. Through his influence Cæsar was proclaimed an enemy to the State, and his rival was appointed general of the army of the republic. Cæsar crossed the Rubicon in 49 (see *Cæsar*), and in sixty days was master of Italy without striking a blow. Pompey crossed over to Greece, and in this country, on the plains of Pharsalia, occurred the decisive battle which made Cæsar master of the Roman world. The defeated triumvir fled to Egypt, where he hoped to find a safe asylum. The ministers of Ptolemy betrayed him, and he was stabbed on landing by one of his former cen-

turons (48 B.C.)—Cf. Sir C. W. C. Oman, *Seven Roman Statesmen of the Later Republic*.

Pompey's Pillar, an ancient monument in Alexandria, Egypt. It consists of a Corinthian capital, shaft, base, and pedestal. The total height of the column is 98 feet 9 inches; the shaft, a monolith of red granite from Aswan, is 67 feet long, and 9 feet in diameter below and not quite 8 feet at top. It was erected in A.D. 302 by a Roman prefect named Posidius, whose inscription appears on the west side of the pedestal, and was dedicated to the Emperor Diocletian. The present name arose from an erroneous statement that the pillar marked the burial-place of Pompey.

Ponce de Leon (pon'the de le-on'), Juan, Spanish explorer, born about 1460, died at Cuba 1521. He accompanied Columbus on his second expedition in 1493, was sent by Ovando to conquer the Island of Porto Rico, and in 1513, during a voyage to the north, discovered Florida. He returned to Spain, and was appointed by Ferdinand Governor of the Island of Florida, as he called it, on condition that he should colonize it. Ponce de Leon was killed by the natives whilst attempting to take possession of his colony in 1521.

Ponce de Leon, Luis, Spanish lyric poet, born in 1527, died 1591. He entered the order of St. Augustine at the age of sixteen, and became professor of sacred literature at Salamanca. He translated the *Song of Solomon* into Castilian, for which he was brought before the Inquisition at Valladolid (1572) and thrown into prison. At the end of five years he was liberated and reinstated in all his offices, and was elected head of his order.

Pondicherry (Fr. *Pondichéry*), a town, capital of the French East Indian settlement of the same name, on the east or Coromandel coast, 85 miles south by west of Madras. Its territory is surrounded on the land side by the British district of South Arcot, and has an area of 115 sq. miles; pop. 46,849. The town stands on a sandy beach, and consists of two divisions separated by a canal. The 'White Town', or European quarter, on the east, facing the sea, is very regularly laid out, with well-built houses. The 'Black Town', or native quarter, on the west, consists of houses or huts of brick or earth, and a few pagodas. There is an iron pier, and railway communication with the South Indian system was opened in 1879. The settlement was purchased by the French from the Bejapoor rajah in 1672, and has been repeatedly in the hands of the British.

Pondoland, a north-eastern maritime territory of Cape Province, South Africa, abutting on Natal, 90 miles from N.E. to S.W., and about 50 miles from N.W. to S.E. It was the last rem-

nant of independent Kaffraria, became a British protectorate in 1884, and was annexed to the Cape in 1894. The native Pondos are of Zulu stock, and number about a quarter of a million people, subdivided into tribes and factions.

Poniatowski, the name of an illustrious Polish family. Stanislas, Count Poniatowski, born 1678, died 1762, is known for his connection with Charles XII, whom he followed into Turkey. He wrote *Remarques d'un Seigneur Polonais sur l'histoire de Charles XII par Voltaire* (Hague, 1741).—His eldest son, Stanislas Augustus, born 1732, the favourite of Catherine II, was elected King of Poland in 1764.—Jozef, the nephew of King Stanislas, born in 1762, served against the Russians in 1792, and in 1794 joined the Poles in their attempt to drive the Russians out of the country, and commanded a division at the sieges of Warsaw. In 1809 he commanded the Polish army against the superior Austrian force which was sent to occupy the Duchy of Warsaw, and compelled it to retire. In 1812 he led the Polish forces against Russia. During the battle of Leipzig, Napoleon created him a marshal.

Ponsard (pon-sär), François, French dramatist, born at Vienne, in Dauphiné, 1814, died 1867. His first success was his *Lucrèce*, produced in 1843, and welcomed as a return to classicism. Among his other pieces are: *Agnès de Méranie*; *Charlotte Corday*; and *L'Honneur et l'argent*, a fine comedy of manners. He became a member of the Academy in 1855.

Ponta-Delgada, a seaport and the capital of the administrative district of St. Michael's (with St. Mary) in the Azores. It is located on the south side of the Island of St. Michael's, and has a good harbour protected by a breakwater over 2500 feet in length. Ponta-Delgada combines its functions as capital with those of a health-resort, and it is also the commercial centre of the archipelago. The chief exports are wheat, maize, and oranges. There is a cathedral, and a monastery of some note. Pop. (1921), 16,179.

Pont-à-Mousson, a town of France, department of Meurthe-et-Moselle, on the canalized River Moselle, and connected by rail with Nancy (17 miles). There is a large church dedicated to St. Martin, and a modern seminary is located within the buildings of the ancient Abbey of St. Mary. Pont-à-Mousson was the seat of a university from 1571 to 1763. The town originated in the ninth century, and was a lordship which became a marquessate about 1354. Pop. 14,009.

Pontefract (colloquially **Pomfret**), a municipal borough and market town of Yorkshire (West Riding), England, on an eminence near the confluence of the Aire and Calder; served by the Midland, Lancashire & Yorkshire, and

North-Eastern Railways. The chief antiquity of the town is the ancient castle, which originally covered 8 acres. It is now partly a museum, and the adjacent lands are used as a public park. Other objects of interest are an ancient hermitage hewn out in solid rock and dating from 1396. On St. Thomas's Hill, Thomas, Earl of Lancaster, was beheaded in 1322, the place being indicated by a windmill. The grammar school, now occupying modern buildings, was founded in the pre-Elizabethan period, and the town hall stands on the site of the old Saxon Moot-Hall, which was superseded by another structure in 1656. Pontefract is noted for the preparation from liquorice of small lozenges, known for centuries as 'Pomfret cakes'. Tanning, brewing, corn-milling, and brick-making are representative industries. Pop. (1921), 16,763.

Pontefract originated in Kirkby, which, in the time of the *Domesday Book*, was a member of the manor of Tateshall (which is now called Tanshelf, and is a suburb of modern Pontefract). Richard II was imprisoned and murdered in the castle in 1399. During the Wars of the Roses, Pontefract espoused the Lancastrian cause and was loyal to Henry VI. Pontefract Castle was the last garrison to hold out for Charles I, and was dismantled in 1649.—BIBLIOGRAPHY: G. Fox, *The History of Pontefract*; B. Boothroyd, *The History of the Ancient Borough of Pontefract*; A. H. Norway, *Highways and Byways in Yorkshire*; T. Paulden, *Pontefract Castle; an account of how it was taken, and how General Rainsborough was surprised at Doncaster, anno 1648* (4to, London, 1702); and *An account of the Taking and Surrender of Pontefract Castle* (4to, Oxford, 1747).

Pontevedra, a maritime province of North-Western Spain, on the Atlantic. All the rivers flow to the Atlantic, the Minho forming the southern boundary; others are the Ulla, Lerez, and Umia. The climate is mild and the rainfall heavy, with heavy fogs in summer and violent storms in winter. Pontevedra (capital), Vigo (seaport), La Estrada, Tuy, and Redondela are important towns. At Tuy the Spanish and Portuguese railways meet and the line bifurcates, one branch following the coast via Redondela (branch to Vigo), and the other traversing the Minho Valley. Cattle are raised, and hams, eggs, wines, and leather are exported. Area, 1695 sq. miles; pop. (1920), 515,984 (or 304.4 per square mile).

Pontevedra (Roman *Duo Pontes* or *Pons Vetus*), a city and the capital of the province of Pontevedra, Spain, on the Bay of Pontevedra, near the mouth of the Lerez; served by the Corunna-Santiago-Tuy line of the Spanish railways. Pontevedra is mainly granite-built, and is partly enclosed by mediæval walls, and

spanning the Lerez there is an ancient Roman bridge (*Pons Vetus*) of twelve arches, from which the town derives its name. There is an extensive sardine-fishery in the Bay of Pontevedra. Pop. about 25,000.

Pon'tifex, the title borne by the members of the most important of the priestly colleges among the Romans. Their institution was ascribed to Numa, and their number varied at different periods from four to sixteen. The *pontifex maximus*, or chief pontiff, held his office for life, and could not leave Italy. In the time of the Empire the office was held by the emperor himself, until the times of Theodosius. The title was subsequently assumed by the Popes.

Pontine Marshes, an extensive, malarious tract of marshy land in Italy, in the southern part of the Roman Campagna, extending along the Mediterranean seaboard for about 27 miles, with a mean breadth of 8½ miles. In ancient times it was well drained, but on the subjugation of the Volscii by the Romans the drainage system became ineffective, and the land assumed practically its present form. By the construction of the Appian Way, Appius Claudius endeavoured to drain it (312 B.C.), and several Popes subsequently made attempts at reclamation. The Italian Government voted a large sum for drainage, but this has been found possible only in parts.

Pontoise (pon-twäz; ancient *Briva Isaræ*), a town of France, in the department of Seine-et-Oise, at the confluence of the Viosne with the Oise. It has manufactures of chemical products and hosiery, and a trade in grain. Pop. about 9000.

Pontoise existed in the time of the Gauls as *Briva Isaræ*, which means Bridge of the Oise, and became the capital of French Vexin. It was a meeting-place on several occasions of the Parlement of Paris, and offered a refuge to Louis XIV and Mazarin during the Fronde.

Pontoon, a flat-bottomed, wooden boat used as a support for the roadway of a floating bridge (from the Lat. *pons*, a bridge). The pontoon in use in the British service is 21 feet long, and is made in two sections, coupled together and known as the bow section and the stern section; of these the bow section is the longer by 2 feet; the beam or width is 5 feet 3 inches, tapering at the bow to 2 feet 6 inches; depth, 2 feet 5 inches. The weight of each section is 5 cwt. The superstructure necessary to complete the bridge consists of a 'saddle beam' fixed on the thwarts of the pontoon, on which are laid the 'baulks' or road-bearers; these in their turn support the 'chesses' or planks which form the roadway, and which are kept in place by 'ribands'; for the shore end other baulks are required.

Special wagons are provided for the carriage

of pontoons and superstructure, one wagon being arranged to carry the two sections of a pontoon and sufficient superstructure for a 'bay' of 15 feet. Trestles of heavy baulks bolted together are often used in combination with pontoons, and both pontoons and trestles form part of the equipment of a field company Royal Engineers, two trestles being carried on a special wagon.

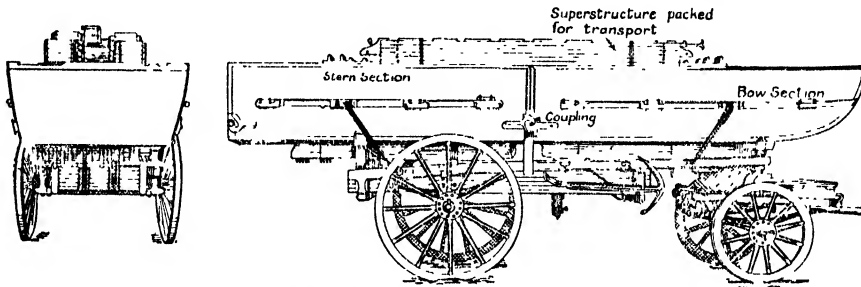
With pontoons three types of bridge, capable of carrying the heaviest loads other than railway trains, can be constructed. These are known as light, medium, and heavy.

Light Bridges.—The floating piers consist of a single pontoon, and a roadway of 9 feet width is provided.

Medium Bridge.—In this type six sections of pontoons are formed into a raft to form each

which extended from Halys on the west to Colchis on the east, and was bounded on the north by the Euxine Sea, and on the south by Galatia, Cappadocia, and Armenia Minor. The first king was Artabazes, son of Darius. The kingdom was in its most flourishing state under Mithridates the Great. But soon after his death (63 B.C.) it was conquered by Pompey, and made tributary to the Roman Empire.

Pontypool, an urban district and market town of Monmouthshire, England, on an acclivity above the Afon Lywd (affluent of the Usk); served by the London & North-Western and Great Western Railways, and by the Monmouthshire Canal, which connects it with Newport. Its existence is due to its proximity to the great South Wales coal-fields. Industries are connected more or less with mining, and



Pontoon Wagon Packed. End and Side Views

pier, and a roadway of about 9½ feet is provided. Chesses are laid double.

Heavy Bridge.—Nine sections are used for each pier, the width of roadway being the same as in a medium bridge. Chesses are laid treble.

Pontoons lend themselves very conveniently to the construction of rafts for various purposes, a four-pontoon raft being capable of carrying 100 infantry soldiers, or 12 horses and their riders, or 1 gun and limber with a proportion of personnel. With three heavy pontoons (length, 41 feet) and special superstructure, a raft to carry up to 35 tons can be made.

Pontoon bridges are normally formed in one of four ways: (a) By connecting the pontoons at the head of the bridge. (b) By making rafts, floating them into position, and then connecting them. (c) By making the bridge alongside the bank, and then allowing it to be swung to the opposite side by the force of the current. (d) By pushing out the head of the bridge and connecting other pontoons successively from the shore, until the original head reaches the other side. This is known as 'booming out'.

Pontus, a kingdom in Asia Minor (so called from the Pontus Euxinus, on which it lay),

with the manufacture of iron and steel and tin-plates. Pop. (1921), 6883.

Pontypridd, an urban district and market town of Glamorganshire, Wales, at the confluence of the Rhondda and the Taff; served by the Great Western and the Taff Vale Railways, and by the Glamorganshire Canal. Pontypridd came into prominence and rapidly progressed when the Taff Vale lines were pushed through in 1840. The name (New Bridge) is derived from the wonderful old one-arch bridge spanning the Taff, which was designed and erected in 1755 by a self-taught mason named Edwards. Pontypridd is the metropolis of the Rhondda Valley, and is dependent on the coal-fields there for existence. There are iron- and brass-foundries, and anchor-, chain-, and chemical-works. Pop. (1921), 47,171.

Pony, the oldest known breed and the smallest variety of the domesticated horse, ranging in height between 8 or 9 and 14 hands. Of the many varieties of ponies the following are typical British breeds:

Connemara, at one time flourished on the mountains of Ireland. It is similar to the Highland pony, has good riding shoulders, and jumps well. In the Irish islands they average 12 hands

2 inches, but may attain 14 hands 1 inch on the mainland, as a result of better food and more suitable climate. The prevailing colour is dun.

Dartmoor, a small and blood-like pony with capital shoulders. Stallions attain 14 hands; mares average 13 hands 2 inches. The prevailing colours are brown, black, or bay; grey is allowable, but other colours are objected to.

Exmoor, a very hardy, untiring pony, capable of carrying enormous loads on little food. It is a handsome animal averaging 12 hands, but should never exceed 13 hands. The prevailing colours are dark-bay or brown, with short black legs.

Highland, the breed that carried the Highlanders of the hills on many a long journey before roads existed in the mountainous regions of North and North-Western Scotland. There are many subdivisions, but the original type cannot be obliterated by crossing. The Barra ponies are of 11 hands 2 inches upwards; Skye, about 13 hands 3 inches; and Mainland breeds vary between 14 hands and 14 hands 2 inches. The Highland is a good saddle pony, capable of wonderful feats of endurance.

New Forest, a good pony of from 12 to 13 hands high; short on the leg, with capital pasterns. All colours are allowable, but dun is not often seen. Greys, however, are frequently met with, and flea-bitten greys are said to be descended from an Arab sent to the Forest by the Prince Consort of Queen Victoria. They are very handsome animals, and possess a striking Arab character.

In the breeding of ponies the fundamental considerations are smallness, beauty, and compactness, combined with practical utility. See *Horse*; *Polo-pony*; *Shetland Pony*.



Poodle

Poodle, a small variety of dog covered with long, curling hair, and remarkable for its great intelligence and affection. The usual colour is white, but black and blue are also bred.

Pool. See *Billiards*.

Poole, an ancient municipal borough and seaport, a county of a town, in Dorsetshire, England, on a peninsula on the north part of Poole Harbour; served by the London & South-Western Railway. Cordage, sailcloth, pottery, flour, and agricultural tools are made. Poole Harbour is an arm of the English Channel extending inland to a depth of about 7 miles, with an average breadth of 5 miles. In the harbour there are several low islands, the largest, Branksea, containing a sixteenth-century castle. From Branksea also potters' clay is sent to the Staffordshire potteries. Pop. (1921), 43,661.

In mediæval times Poole was a flourishing seaport, which was incorporated and crected into a county by Elizabeth (1569). Charles II gave it a charter in 1667, and it was separately represented in Parliament from 1362 until 1885.

Poonah, or **Puna**, a city and District of India, in the Presidency of Bombay, and at the confluence of the Mula and Mutha Rivers; served by the Great Indian Peninsular Railway from Bombay. The Deccan college for classics, mathematics, and philosophy, and a college of science with special training in civil engineering, also training college, female normal school, and other schools, public library, hospital, arsenal, and barracks are established at Poonah. It is a health-resort, and from July to November is the seat of the Bombay Government. Manufactures include gold and silver jewellery, small ornaments in brass, copper, and ivory, and silk and cotton fabrics. It is an important military station and road junction. Until 1817 Poonah was the capital of the Peshwa rulers of the Marathi Confederacy. A battle was fought there on 16th Nov., 1817, between the British and the Peshwa, and the city fell to the British on 19th Nov. Pop. 100,000.—The District has an area of 5348 sq. miles, and a pop. of 1,100,000. It is an elevated tableland, watered by the Bhima and its tributaries, and abounding in isolated heights, formerly crowned with strong fortresses. Inhabitants chiefly Marathis.

Poon (or **Poona**) **Wood** is the wood of the poon tree (*Calophyllum inophyllum* and *Calophyllum angustifolium*), a native of India. It is of a light, porous texture, and is much used in the East Indies in shipbuilding for planks and spars. The Calcutta poon is preferred to that of other districts. Poon seed yields an oil called *dilo*, poon-seed oil, &c.

Poor and Poor Laws. A full history of the poor, in the widest sense in which the term is used, would be a history of the bulk of mankind, since the standard of living varies in different countries and at different times, and the majority of human beings are always in danger of sinking below the current standard. Here, however, it will be possible only to give

some account of the legal poor; of the provision which has been made from time to time by the State for the relief of destitution in Great Britain.

The origins of the poor law are derived from feudalism. The obligation of the serf to work on the manor carried with it a certain right to maintenance. When this condition of 'status' gradually changed to a system of contract, the duty of maintaining the destitute labourer was transferred from the manor to the parish. According to a passage quoted from Horne's *Mirror in Coke's Institutes*, it was ordained by kings before the Conquest that the poor should be sustained by parsons, rectors, and parishioners, "so that no one should die from lack of sustenance". The Poor Relief Act, 1601 (43 Elizabeth c. 2), which closed a series of experimental laws passed in the Tudor period for the relief of the impotent poor and the regulation of begging, is generally treated as the first English poor law. This measure was passed for a limited period only, but it was renewed at the beginning of the reign of James I, and made perpetual in 1641. Its chief purposes were:

(a) "For setting to work the Children of all such whose Parents shall not by the said Churchwardens and Overseers . . . be thought able to keep and maintain their children;

(b) "And also for setting to work all such persons, married or unmarried as having no Means to maintain them, use no ordinary or daily Trade of Life to get their Living by;

(c) "And also to raise weekly or otherwise (by taxation of every Inhabitant . . .) a convenient Stock of Flax, Hemp, Wool, Thread, Iron, and other Ware and Stuff, to set the Poor on Work;

(d) "And also competent Sums of Money for and towards the necessary Relief of the Lame, Impotent, Old, Blind, and such other among them being Poor and not able to work;

(e) "And also for the putting out of such Children to be Apprentices . . ."

In the reign of Charles II an Act was passed, which is usually called the 'Settlement Act', the effect of which was to prevent labourers from moving freely from one parish into another. This Act was denounced by Adam Smith as "an evident violation of natural liberty and justice", and was modified in 1795.

The period between 1793 and 1815 was one of almost continuous war; prices rushed up, harvests were exceptionally bad, the population increased with a rapidity hitherto unknown, and food was at famine prices. In May, 1795, the magistrates of Berkshire met at Speenhamland and decided to supplement wages out of the parish rates. They drew up and published a scale, by which every poor and industrious

person should receive from the parish enough to make up his wages to 3s. a week for himself and 1s. 6d. a week for each member of his family, when the loaf cost a shilling. If the price of bread rose, the dole was to be increased proportionately. The magistrates in many other counties adopted the same scale, and the result was that agricultural wages remained unduly low, pauperism became general, and the poor rate rose rapidly.

In 1832 a Commission was appointed "to make diligent and full inquiry into the practical operation of the laws for the relief of the poor in England and Wales, and into the manner in which those laws were administered, and to report their opinion as to what beneficial alterations could be made". The Commissioners reported that "the great source of abuse was the outdoor relief afforded to the able-bodied on their own account or on that of their families, given either in kind or in money", and that "great maladministration existed in the workhouses". They proposed considerable alterations in the law, and most of their suggestions were carried out in the Poor Law Amendment Act, 1834.

The intention of this Act was to restore the original provisions of the statute of Elizabeth by which relief to able-bodied persons or their families was to be given in workhouses, while outdoor relief was confined to the impotent. As no important change has been made in the poor law since 1834, we may thus be said to administer relief to the destitute in 1922 on the principles laid down in 1601; but the provision of Old Age Pensions and Health and Unemployment Insurance has greatly reduced the number of persons dependent upon the rates.

The administration of the poor law is controlled by the Ministry of Health (the Local Government Board until 1919), which issues orders to local boards of guardians, elected by the ratepayers. These guardians can, within the discretion allowed to them by statutes and orders, vary the procedure very considerably between one parish and another; with the result that a class of applicants who have no chance of receiving outdoor relief in one union may get it easily in another.

That the English poor law is unsatisfactory in many respects has long been generally admitted. In 1905 a Royal Commission was appointed to investigate the whole system. The result was a majority report, signed by the chairman and thirteen other members, and a minority report, signed by four members. Both reports recommended great changes, including the abolition of workhouses, but the majority aimed at the reform of the existing

system, while the minority advocated its abolition. In 1918 the Local Government Committee of the Ministry of Reconstruction, which included representatives of both the Majority and Minority Commissioners and leading officials of the Local Government Board, recommended the abolition of the boards of guardians and the distribution of their present functions among local government, public health, and education authorities.

The distinguishing features of the Scottish poor law have always been the refusal of relief to the able-bodied and the outdoor relief of the impotent. Some of the greatest difficulties of English administration have thus been avoided in Scotland, though in other respects the systems are similar.—BIBLIOGRAPHY: Nicholls, *History of the English Poor Law*; B. Webb, *The Prevention of Destitution*; article in Palgrave's *Dictionary of Political Economy*.

Poor's Roll, a roll or list of paupers, or persons entitled to or who have received parochial relief. In *Scots law* it is the list of litigants who, by reason of poverty, have the privilege of suing or defending a case in court *in forma pauperis*, by which they are exempted from the payment of any court fees, and are entitled to have their case conducted gratuitously by the counsel and agents for the poor.

Popayán, a city of Colombia, capital of the department of Cauca, on a plain between the Purace Volcano (15,420 feet altitude) and one of the tributaries of the headwaters of the Cauca. It is the seat of a Roman Catholic archbishopric, and of the departmental University of Popayán, once of considerable reputation. The bishopric dates from 1547. Pop. 19,000.

Popayán was founded in 1538, and the name is eponymous, commemorating Payan, an Indian chief, upon the site of whose settlement the town was founded. It was for long of commercial importance, but the manufactures are now negligible.

Pope (Lat. *papa*; Gr. *papas*, father), the title at present given solely to the Bishop of Rome, who is the head of the Roman Catholic Church. Besides the bishopric of the Roman diocese, the Pope also holds certain other dignities. His full title is as follows: Bishop of Rome, Vicar of Jesus Christ, Successor of St. Peter, Supreme Pontiff of the Universal Church, Patriarch of the West, Primate of Italy, and Sovereign of the Temporal Dominions of the Holy Roman Church. The title seems to have been used at first in the early Church as a title of reverence given to ecclesiastics generally, and at the present time it is applied in the Greek Church to all priests. In the early Western Church the title of Pope was ultimately bestowed upon the metropolitan bishops, but in

the struggle for pre-eminence the claim to be recognized as the only Pope was enforced by the Bishop of Rome. This claim of pre-eminence was founded on the belief, supported by the early traditions of the Church, that the Apostle Peter planted a Church in Rome, and that he died there as a martyr. This tradition, taken in connection with the alleged pre-eminence of Peter among Christ's disciples, came to be regarded as sufficient reason for the primacy of the Bishop of Rome in the Church. Consequently from the end of the fourth century the Bishop of Rome was the first among the five patriarchs or superior bishops of Christendom. A decree of the Emperor Valentinian III (445) acknowledged the Bishop of Rome as Primate, but until the eighth century many measures of the Popes met with violent opposition. Leo the Great (440–461) was the first to base his claims to the primacy on divine authority by appealing to *Matt.* xvi, 18; and he did much to establish the theory that bishops in disputes with their metropolitans had a right of appeal to Rome. The Eastern Church always resisted the see of Rome, and this mainly occasioned the schism that in 1054 divided Christendom into the Greek and Roman Churches.

Although the temporal power of the Pope has ceased to exist, and his territory has been confined to the palaces of the Vatican and the Lateran, and the villa of Castel Gandolfo, Rome, for Roman Catholics he is still the supreme authority in all matters of faith. He has supreme powers in all matters of discipline and faith over all and each of the pastors and of the faithful. The special prerogatives of the Pope were clearly defined by the Decrees of the Vatican Council of 1870. This Council also taught that when the pontiff speaks *ex cathedra*, that is, when he, in virtue of his apostolic office, defines a doctrine of faith and morals to be held by the whole Church, he possesses infallibility by divine assistance. The Pope cannot annul the constitution of the Church as ordained by Christ. He may condemn or prohibit books, alter the rites of the Church, and reserve to himself the canonization of saints. A Pope has no power to nominate his successor, election being entirely in the hands of the cardinals, who are not bound to choose one of their own body. The Pope's dress consists of a white silk robe and a scarlet mantle. The Pope ranks as the first of Christian Princes, and in Catholic countries his ambassadors have precedence over other members of the diplomatic corps. The Papal insignia are the tiara or triple crown, the straight crosier, and the pallium. He is addressed as 'Your Holiness', and refers to himself as *Servus Servorum Dei*, servant of the servants of God. For a history of the

papacy see *Papacy*. — **BIBLIOGRAPHY:** II. K. Mann, *Lives of the Popes in the Early Middle Ages*; L. Pastor, *History of the Popes from the Close of the Middle Ages*.

Subjoined is a table of the Popes, according to the Roman Notizie, with the dates of the commencement of their pontificates. The names printed in italics are those of Antipopes:

St. Peter .. .	A.D. 42	Boniface V .. .	619
St. Linus .. .	66	Honorius I .. .	625
St. Anacletus .. .	78	(See vacant 1 year and 7 months.)	
St. Clement I .. .	91	Severinus .. .	640
St. Evaristus .. .	100	John IV .. .	640
St. Alexander I .. .	108	Theodorus I .. .	642
St. Sixtus I .. .	119	St. Martin I .. .	649
St. Telephorus .. .	127	St. Eugenius I .. .	654
St. Hyginus .. .	139	St. Vitalianus .. .	657
St. Pius I .. .	142	Adeodatus .. .	672
St. Anicetus .. .	157	Donus or Domnus I .. .	676
St. Soterus .. .	168	St. Agathon .. .	678
St. Eleutherius .. .	177	St. Leo II .. .	682
St. Victor I .. .	193	St. Benedict II .. .	684
St. Zephyrinus .. .	202	John V .. .	685
St. Callixtus I .. .	217	Conon — <i>Theodorus</i> ;	
St. Urban I .. .	223	<i>Paschal</i> .. .	686
St. Pontianus .. .	230	St. Sergius I .. .	687
St. Anterus .. .	235	John VI .. .	701
St. Fabian .. .	236	John VII .. .	705
St. Cornelius .. .	250	Sisinnius .. .	708
St. Lucius I — <i>Novatus</i> .. .	252	Constantine .. .	708
St. Stephen I .. .	253	St. Gregory II .. .	715
St. Sixtus II .. .	257	St. Gregory III .. .	731
St. Dionysius .. .	259	St. Zachary .. .	741
St. Felix I .. .	269	Stephen II (died before consecration) .. .	752
St. Eutychianus .. .	275	Stephen III .. .	752
St. Caius .. .	283	St. Paul I — <i>Constantine</i> ;	
St. Marcellinus .. .	296	<i>Theophylactus</i> ; <i>Philip</i>	757
(See vacant 3 years and 6 months.)		Stephen IV .. .	768
St. Marcellus I .. .	308	Adrian I .. .	772
St. Eusebius .. .	310	St. Leo III .. .	795
St. Melchisedes or Melchisedes .. .	311	Stephen V .. .	816
St. Sylvester I .. .	314	St. Paschal I .. .	817
St. Marcus .. .	336	Eugenius II .. .	824
St. Julius I .. .	337	Valentinus .. .	827
Liberius .. .	352	Gregory IV .. .	827
St. Felix II (sometimes reckoned an Antipope) .. .	355	Sergius II .. .	844
St. Damasus I .. .	366	St. Leo IV .. .	847
St. Siricius .. .	384	Benedict III — <i>Anastasius</i> .. .	855
St. Anastasius I .. .	398	St. Nicholas I .. .	858
St. Innocent I .. .	402	Adrian II .. .	867
St. Zosimus .. .	417	John VIII .. .	872
St. Boniface I — <i>Eulalius</i> .. .	418	Marinus I, or Martin II .. .	882
St. Celestine I .. .	422	Adrian III .. .	884
St. Sixtus III .. .	432	Stephen VI .. .	885
St. Leo I (the Great) .. .	440	Formosus .. .	891
St. Hilary .. .	461	Boniface VI (reigned only 18 days) .. .	896
St. Simplicius .. .	468	Stephen VII .. .	896
St. Felix III .. .	483	Romanus .. .	897
St. Gelasius I .. .	492	Theodorus II — <i>Sergius</i> III .. .	898
St. Anastasius II .. .	496	John IX .. .	898
St. Symmachus .. .	498	Benedict IV .. .	900
St. Hormisdas — <i>Lawrence</i> .. .	514	Leo V .. .	903
St. John I .. .	523	Christopher .. .	903
St. Felix IV .. .	526	Sergius III .. .	904
Boniface II — <i>Dioscorus</i> .. .	530	Anastasius III .. .	911
John II .. .	533	Lando .. .	913
St. Agapetus I .. .	535	John X .. .	914
St. Sylvester .. .	536	Leo VI .. .	928
Vigilius .. .	537	Stephen VIII .. .	929
Pelagius I .. .	555	John XI .. .	931
John III .. .	560	Leo VII .. .	936
Benedict (I) Bonosus .. .	574	Stephen IX .. .	939
Pelagius II .. .	578	Marinus II, or Martin III .. .	943
St. Gregory I (the Great) .. .	590	Agapetus II .. .	946
Sabinianus .. .	604	John XII — <i>Leo VIII</i> .. .	956
Boniface III .. .	607	Benedict V .. .	964
St. Boniface IV .. .	608	John XIII .. .	965
St. Deuededit .. .	615		

Benedict VI .. .	972	(See vacant 2 years and 3 months.)	
Donus or Domnus II .. .	974	St. Celestinus V .. .	1294
Benedict VII .. .	975	Boniface VIII .. .	1294
John XIV — <i>Boniface VII</i> .. .	A.D. 983	Benedict XI .. .	1303
John XV .. .	985	Clement V (papacy removed to Avignon) .. .	1305
Gregory V — <i>John XVI</i> .. .	985	(See vacant 2 years and 3 months.)	
Sylvester II .. .	999	John XXII .. .	1316
John XVI or XVII .. .	1003	Benedict XII — <i>Nicholas V at Rome</i> .. .	1334
John XVII or XVIII .. .	1003	Clement VI .. .	1342
Sergius IV .. .	1009	Innocent VI .. .	1352
Benedict VIII — <i>Gregory VI</i> .. .	1012	Urban V — <i>Clement VII</i> .. .	1362
John XVIII or XIX .. .	1024	Gregory XI (throne restored to Rome) .. .	1370
Benedict IX (deposed) — <i>John XX</i> .. .	1033	Boniface IX — <i>Benedict XIII at Avignon</i> .. .	1378
Gregory VI — <i>Sylvester III</i> .. .	1045	Innocent VII .. .	1389
Clement II .. .	1046	Gregory XII .. .	1404
Damasus II — <i>Benedict IX</i> attempts to resume the throne .. .	1048	Alexander V .. .	1406
St. Leo IX .. .	1049	John XXIII .. .	1410
Victor II .. .	1055	Martin V — <i>Clement VIII</i> .. .	1417
Stephen X .. .	1057	Eugenius IV — <i>Felix V</i> .. .	1431
Benedict X .. .	1058	Nicholas V .. .	1447
Nicholas II .. .	1058	Callixtus III .. .	1455
Alexander II — <i>Honorius II</i> .. .	1061	Pius II .. .	1458
Gregory VII (Hildebrand) — <i>Clement III</i> .. .	1073	Paul II .. .	1464
(See vacant 1 year.)		Sixtus IV .. .	1471
Victor III .. .	1086	Innocent VIII .. .	1484
Urban II .. .	1088	Alexander VI .. .	1492
Paschal II .. .	1099	Pius III .. .	1503
Gelasius II — <i>Gregory VIII</i> .. .	1118	Julius II .. .	1503
Callixtus II .. .	1119	Leo X .. .	1513
Honorius II — <i>Celestine II</i> .. .	1124	Adrian VI .. .	1522
Innocent II — <i>Anacletus II</i> ; <i>Victor IV</i> .. .	1130	Clement VII .. .	1523
Celestinus II .. .	1143	Paul III .. .	1534
Lucius II .. .	1144	Julius III .. .	1550
Eugenius III .. .	1145	Marcellus II .. .	1555
Anastasius IV .. .	1153	Paul IV .. .	1555
Adrian IV (Nicholas Breakspear, an Englishman) .. .	1154	Pius IV .. .	1559
Alexander III — <i>Victor V</i> ; <i>Paschal III</i> ; <i>Callixtus III</i> ; <i>Innocent III</i> .. .	1159	St. Pius V .. .	1566
Lucius III .. .	1181	Gregory XIII .. .	1572
Urban III .. .	1185	Sixtus V .. .	1585
Gregory VIII .. .	1187	Urban VII .. .	1590
Clement III .. .	1187	Gregory XIV .. .	1590
Celestinus III .. .	1191	Innocent IX .. .	1591
Innocent III .. .	1198	Clement VIII .. .	1592
Honorius III .. .	1216	Leo XI .. .	1605
Gregory IX .. .	1227	Paul V .. .	1605
Celestinus IV .. .	1241	Gregory XV .. .	1621
(See vacant 1 year and 7 months.)		Urban VIII .. .	1623
Innocent IV .. .	1243	Innocent X .. .	1644
Alexander IV .. .	1254	Alexander VII .. .	1655
Urban IV .. .	1261	Clement IX .. .	1667
Clement IV .. .	1265	Clement X .. .	1670
(See vacant 2 years and 9 months.)		Innocent XI .. .	1676
Gregory X .. .	1271	Alexander VIII .. .	1680
Innocent V .. .	1276	Innocent XII .. .	1691
Adrian V .. .	1276	Clement XI .. .	1700
John XIX or XX or XXI .. .	1276	Innocent XIII .. .	1721
Nicholas III .. .	1277	Benedict XIII .. .	1724
Martin IV .. .	1281	Clement XII .. .	1730
Honorius IV .. .	1285	Benedict XIV .. .	1740
Nicholas IV .. .	1288	Clement XIII .. .	1758
		Clement XIV .. .	1769
		Pius VI .. .	1775
		Pius VII .. .	1800
		Leo XII .. .	1823
		Pius VIII .. .	1829
		Gregory XVI .. .	1831
		Pius IX .. .	1846
		Leo XIII .. .	1878
		Pius X .. .	1903
		Benedict XV .. .	1914
		Pius XI .. .	1922

Pope, Alexander, English poet, was born on 21st May, 1688, and died on 30th May, 1744. His father was a Roman Catholic linen-draper of Lombard Street; his mother's maiden name was Edith Turner, and she was of a good middle-class family. He was the only child of the

marriage, and both his parents were nearly fifty years of age when he was born. He inherited a tendency to nervous headaches from his mother, and a feeble frame from his father. His delicacy of health was greatly increased by his precocious application to study. Owing to his health or his religion or both he did not attend any good school or college, but was sent to one or two small Catholic schools, and received private tuition from one or two incompetent Catholic priests. He was thus largely self-taught, and, although he assimilated much knowledge of various kinds and was indefatigable in his devotion to his books, he was never a scholar. His religion closed the learned professions to him, and his physique rendered him unfit for commercial life, so he early decided to devote himself to literature, after a brief attempt to become efficient as a painter. His father adopted a wise policy of non-interference, being always ready to help his brilliant son, but never anxious to dictate to him.

While still at school he wrote a play based on Ogilby's translation of the *Iliad*, and an epic called *Alcander, Prince of Rhodes*. Both these compositions are lost. He made the acquaintance of the dramatist Wycherley, who encouraged him to write pastorals, and of the critic Walsh, who recommended him to write 'correctly', a piece of advice which he never forgot. Long afterwards Pope published his correspondence with Wycherley, after emending it so as to make his own conduct appear in a favourable light. Pope apprenticed himself to the art of poetry with the greatest ardour. He studied widely, and experimented in translating and adapting. Dryden was his model, and in imitation of him he 'translated' some Chaucer, *The Merchant's Tale*, *The Wife of Bath's Prologue*, and *The House of Fame*, and made a version of the first book of the *Thebais* of Statius to set against Dryden's *Æneid*. It is typical of his not impeccable taste that he ranked Statius as the equal of Virgil. Work of this kind increased his powers, and developed his great natural gifts as a metrist. His *Pastorals* were published in 1709 in a miscellany which included similar work by Ambrose Philips, whom Pope afterwards held up to ridicule in *The Guardian*, and immortalized as 'Namby-pamby' in *The Dunciad*. *The Essay on Criticism* appeared in 1711; it is an astonishingly mature poem, full of sound precepts, and brilliantly written. It was not intended, as some critics seem to suppose, to supersede Aristotle and Horace; it was intended to express in the choicest language some of the commonplaces of contemporary criticism, and could not have attained its object more fully than it has done. *The Messiah*, a sacred eclogue, which was No. 378 of *The Spec-*

tator, was in its time a much-admired poem, but it reads to-day somewhat like a copy of verses sent in for the Seatonian Prize. *The Rape of the Lock* appeared in its original form in 1712; in 1714 it appeared in its final and greatly improved form, with the 'machinery' of sylphs and gnomes added. Robert, seventh Baron Petre, had cut off a lock of Miss Arabella Fermor's hair, and the poem was intended to heal the breach in friendship caused by this action. *The Rape of the Lock*, which was written in imitation of Boileau's *Lutrin*, far surpassed its model, and remains the greatest of mock-heroic poems. It was the first poem to impress upon the French the fact that they had not the entire monopoly of exquisitely finished and dainty workmanship. It is perhaps for this reason that the French critic Taine has done such signal injustice to this poem. *Windsor Forest*, an artificial poem of no great merit, appeared in 1713. About this time Pope commenced his life-long friendship with Swift.

In 1713 Pope definitely embarked upon the enterprise of translating Homer. This work was to be published by subscription, and most of the eminent men of the day gave their support to the undertaking. The *Iliad* was published between 1715 and 1720, and the *Odyssey* was completed by 1725. The translation of the *Iliad* was entirely the work of Pope, though the notes were by different hands; Elijah Fenton translated four books of the *Odyssey*, and William Broome eight. Pope's treatment of his collaborators was unjust and far from generous; though it was entirely to his name that the enterprise owed its success. He cleared over £8000 by his *Homer*; this being the first instance in English literature of a substantial fortune made by a man of letters. He invested his money securely, and lived in comfort for the rest of his life. Opinions will always differ as to the merits of Pope's translation; most critics will agree with Bentley, who said, "A fine poem, Mr. Pope, but you must not call it Homer". Sir Leslie Stephen said that Pope's ignorance of Greek was "an awkward qualification for a translator of Homer", but the ignorance of poetry displayed by most other Homeric translators is a qualification hardly less awkward. Other translations cannot be called Homer either, and few of them can be called fine poems. Whatever benefit Pope conferred upon literature by translating Homer, the effect of his translation upon his own work was entirely salutary. From his labours he gained something of that solidarity and complete mastery of his materials that Shakespeare gained by writing his English historical plays.

In 1725 Pope published an edition of Shakespeare's plays in six volumes. He was in many

ways singularly ill-fitted for this task, being without many of the qualities required by a Shakespearean editor. He was especially lacking in patience. Still, he made many improvements in the text, and many acute suggestions in his notes. Shakespeare never again had the advantage of being edited by a man of genius and a poet, since Johnson was no poet, and many of the later editors were undistinguished by the slightest talent, and unacquainted with the rudiments of poetry. Pope's Shakespeare had the effect of embroiling him in a quarrel with Lewis Theobald the critic, who became the hero of *The Dunciad*, which first appeared in 1728. In a later edition Theobald was dethroned, and Colley Cibber, poet-laureate and poetaster, reigned in his stead. *The Dunciad* is a masterly satire upon pedants and dunces; it is not malignant, as it has sometimes been represented as being, but is rather inspired by a love of mischief and malice. Pope could not say with Swift, "I am misanthropos, and hate mankind"; he hated his critics and enemies only, and contrived to settle many old scores in this remarkable poem. Pope's *Essay on Man* (1733) was largely an exposition of the clear but shallow philosophy of Lord Bolingbroke, which was called by the irreverent 'The New Gospel according to St. John'. It is brilliantly written, and full of phrases which have become part of the language. Its orthodoxy was ably defended by Warburton, who became the accepted commentator upon the works of Pope. The *Moral Essays* and *Imitations of Horace* contain much of Pope's best work, though they are marred to some extent by too much bitterness. No poems in all English literature are more vigorous and terse.

The transactions which led up to the publication of Pope's letters in a 'genuine' edition of 1737 are tortuous and complicated beyond unravelling here. The facts were investigated by C. W. Dilke with exemplary patience. The letters themselves are not interesting, having been in some cases written with a view to publication, and in many cases too carefully edited by their author.

In making an estimate of Pope as a man and as an author it is necessary always to bear in mind his physical infirmities. It was his deformed body which made him super-sensitive, and it was his super-sensitiveness which made him so unforgiving an enemy. His good qualities were numerous and vital; he was a devoted son to both father and mother, a faithful friend to those who were faithful to him, and honourably independent as a literary man. The worst of his faults was vanity, which made him conceal the amount of sheer hard work some of his poems cost him, and caused him to attribute

to his extreme youth work done or at any rate revised at a later date. Honourable in his private life, when it came to literary transactions Pope adopted a tortuous policy of a kind usually associated in the English mind with the followers of Ignatius Loyola. Pope lived in an age of venom, when party feeling ran higher than it had done before or has done since. He was a bitter controversialist because all his contemporaries were equally bitter, though less able. He would have been a better artist had he remembered Bentley's dictum that no man was ever written out of reputation but by himself.

As a poet Pope was long immoderately praised, and then the tide turned and he was unduly depreciated. He has been attacked as a corrupter of taste and the founder of a school of machine-made poetry. The truth is that he was the chief ornament and culminating point of a school rather than its tyrannical head or founder. He was not a literary dictator like Ben Jonson or his namesake Samuel; he did not wield the bludgeon, but the rapier, though like that of Laertes it was 'unbated and envenomed'. Pope simply brought to completion the poetical methods of Dryden, Waller, and others. As regards metre, his services to the heroic couplet were like those of Ovid to the elegiac couplet. He brought it to an almost monotonous perfection. He was a scrupulous reviser of his work, as careful as Tennyson, and a better self-critic. His work could hardly be bettered; he has provided us with a multitude of quotations, as apt as those of his favourite Horace. In an artificial age, somewhat given to foppery, he had the good taste to translate the world's greatest epic poet and to edit the world's greatest dramatic poet. True, he performed neither task well, but his attempt shows the natural vigour of his mind. His keen, incisive lines will live when much so-called 'natural' poetry has been forgotten.—BIBLIOGRAPHY: Sir L. Stephen, *Pope* (English Men of Letters Series); C. W. Dilke, *The Papers of a Critic*; W. J. Courthope, *The Life of Alexander Pope*; O. Elton, *The Augustan Ages*; J. Dennis, *The Age of Pope*; S. T. Coleridge, *Biographia Literaria*; W. Wordsworth, *Preface to Lyrical Ballads*.

Poperinghe, a town of West Flanders, Belgium, on the Vleirbeck, a tributary of the Yser. It is a centre of the hop-growing industry, and trades in pottery, lace goods, and locally raised tobacco. There are also tanneries. Pop. about 11,500.

Poperinghe was reduced to insignificance by its larger and more powerful neighbour Ypres in the fourteenth century. During the European War it was invested by the Germans, but was retaken (Oct., 1914) and became a British army centre. In April, 1918, during Ludendorff's great drive, it was fiercely bombarded by the Germans,

Popish Plot, the name given to an imaginary conspiracy which Titus Oates (q.v.) pretended to have discovered in 1678, and by which he succeeded in deluding the mind of the nation over a space of two years, and causing the death of many innocent Catholics. Oates alleged that the plot was formed by the Jesuits and Roman Catholics for the purpose of murdering the king, Charles II, and subverting the Protestant religion. Godfrey, a justice of the peace to whom Oates gave evidence, was found dead in a ditch (17th Oct.), and the Papists were accused of his murder, though nothing transpired to substantiate the charge. Parliament met soon afterwards, and the Commons passed a Bill to exclude Catholics from both Houses. Oates received a pension, and this encouraged Bedloe, a noted thief and impostor, to come forward and confirm Oates's statements. In 1680 Viscount Stafford was impeached by the Commons, condemned by the Lords, and executed (29th Dec.) as an accomplice of the plot, on the evidence of Oates and two of his associates. Soon after the accession of James II (1685) Oates was convicted of perjury and other crimes.

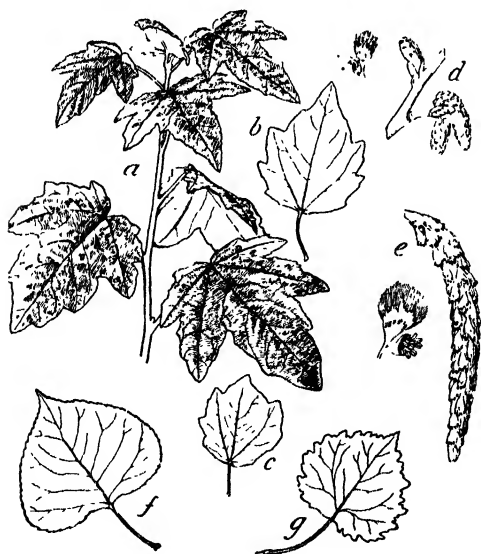
Poplar (*Populus*), a well-known genus of hardy deciduous trees, nat. ord. Salicaceæ, with

tically, the leaves having generally more or less of a tremulous motion. About eighteen species have been observed, natives of Europe, Central and Northern Asia, and North America. Some of the poplars are the most rapid growers of all hardy forest trees. They thrive under a variety of conditions as regards soil, &c., but do best in damp situations. The timber of the poplar is white, light, and soft, and not very valuable. *P. fastigiata*, the common Lombardy poplar, is well known as a tall tree with slender branches almost upright; it reaches a height of 100 to 150 feet. *P. nigra* is the common black poplar. *P. tremula* is the aspen. *P. alba*, the white poplar, often attains a height of 100 feet. *P. balsamifera* is the balsam-poplar or tacamahac of the United States; *P. monilifera*, the cotton-wood of America; *P. canadensis*, the Ontario poplar.

Poplar, an eastern metropolitan borough of London. It is part of the densely populated and dingy area of London known as the East End, and includes the parishes of Bow, Poplar, and Bromley, with the East and West India Docks, Millwall Docks, Blackwall, and the Isle of Dogs. Blackwall has been a commercial shipping-centre from remote times, and Sir Walter Raleigh and Sebastian Cabot are said to have lived there. Two tunnels connect Poplar with the southern side of the Thames. The first was constructed in 1902 for foot passengers, and runs from Cubitt Town (Isle of Dogs) to Greenwich. The other lies lower down the river and is known as the Blackwall Tunnel, and was completed in 1897. Poplar Hospital dates from 1855, and treats about 100,000 patients annually. Pop. (1921), 162,618.

Poplin, a fabric with a maximum number of fine warp threads and a minimum number of thick weft threads, the structure forming the well-known ribbed effect termed repp. In the best poplins the warp is of silk and the weft of woollen or worsted, the weft being entirely hidden. In the cheaper makes worsted yarns are used for warp, and cheap woollen yarns for weft. Figured poplins are very common, but the above general structure is maintained. The manufacture of poplin was introduced into Ireland from France in 1775 by Protestant refugees, and Ireland is still famous for its production.

Popocatepetl (Aztec, *popoca*, to smoke, and *tepētl*, a mountain), an active volcano in Mexico, in the province of Puebla; lat. 18° 59' 47" N.; long. 98° 33' 1" W.; altitude, 17,884 feet. The crater is 3 miles in circumference and 1000 feet deep, and provides pure sulphur, which is secured by the Indians and sent down by chute. To an altitude of 13,000 feet the mountain slopes are afforested. Diego de Ordez, sent by



Poplars

a, b, c, Leaves from the same tree of White Poplar (*Populus alba*). d, Female catkins. e, Male catkin. f, Leaf of Black Poplar (*Populus nigra*). g, Leaf of Aspen (*Populus tremula*).

both barren and fertile flowers in catkins, stamens four to thirty, leaves alternate, broad, with long and slender footstalks flattened ver-

Cortés, was the first European to ascend the mountain (1519). Although the last eruption was in 1802, the snow-cap disappeared prior to the great Mexican earthquakes of 1909, and from this it may be inferred that there is still some volcanic activity present.

Poppy, the common name for plants of the genus *Papáver*, type of the ord. *Papaveraceæ*. The species of poppy are herbaceous plants, all bearing large, brilliant, but fugacious flowers. The white poppy (*P. somniferum*) yields the well-known opium of commerce. (See *Opium*.) Most of the species are natives of Europe, and four are truly natives of Britain. They often occur as weeds in fields and waste places, and are frequently also cultivated in gardens for ornament. The seeds of the white poppy yield a fixed harmless oil employed for culinary purposes; and the oil-cake is used for feeding cattle. The roots of the poppy are annual or perennial; the calyx is composed of two leaves, and the corolla of four petals; the stamens are numerous, and the capsule is one-celled, with several longitudinal partitions, and contains a multitude of seeds.

Population. By the population of a country is meant the total number of human beings living within its frontiers; and the economic theory of population is concerned with the causes which bring about changes in that number. The population of this country is ascertained by a *census*, taken every ten years, and there are similar provisions for the periodic enumeration of the people in all civilized countries. The most notable feature of the returns for the last quarter of a century has been the decline in Western Europe of both the birth-rate and the death-rate. The lower birth-rate is attributed mainly to the deliberate limitation of families; the lower death-rate to better methods of combating disease, especially among infants. The principal figures are given in the *Statesman's Year Book*.

Economic Theory.—Most animals and plants have a reproductive power far in excess of the space and nourishment available upon the earth to enable their offspring to grow to maturity. Their numbers are held in check mainly by the simple process of starvation. Mankind alone has learned how, through co-operation, to exercise a vast control over his environment, and to make the soil yield far more human food than it would yield unaided. Nevertheless, even human beings are ultimately restricted in number by their pressure upon the means of subsistence. In favourable circumstances, such as, for instance, those of North America during the eighteenth century, the population has been known to double itself every twenty or twenty-five years, apart from any increase due to

immigration. What prevents the population of the whole world from increasing at the same rate? The answer to this question was given by Thomas Robert Malthus in his *Essay on the Principle of Population*, first published in 1798. The ultimate check to population, he said, appears to be a want of food; but this ultimate check is never the immediate check, except in cases of actual famine. The immediate check consists in "all those customs, and all those diseases, which seem to be generated by a scarcity of the means of subsistence; and all those causes, independent of this scarcity, whether of a moral or physical nature, which tend prematurely to weaken and destroy the human frame". These checks to population, which are constantly operating with more or less force in every society, are all resolvable, according to Malthus, into "moral restraint, vice, and misery".

Malthus's *Essay* is the classic exposition of the economic theory of population, but it does not clearly explain why the supply of human food should not increase as rapidly as the population. "For every mouth God sends a pair of hands." Why, therefore, should not the soil be made to yield subsistence for any number of human beings, however great? It remained for Ricardo and John Stuart Mill to formulate the law, or tendency, of diminishing returns in agriculture, which answers this question.

Land differs from the other agents of production, labour and capital, in that its supply is, broadly speaking, fixed and unalterable. An increase in population implies an increase in the supply of labour. The supply of capital will probably expand at least proportionately to the increase in population. But the supply of land remains unchanged. Nevertheless, as the population increases, the demand for land increases, and, the supply being fixed, men are obliged to study the means by which they can bring new and presumably inferior land into cultivation, or get an ever-increasing quantity of produce from the same quantity of land. There are two ways in which this can be done. The first is by discovering and applying improved methods of production. The second is by using increasing quantities of the other agents of production—capital and labour. Turgot said: "Seed thrown on a soil naturally fertile but totally unprepared would be expenditure almost entirely wasted. If the ground were once tilled the produce would be greater; tilling it a second and a third time might not merely double and triple, but quadruple or decuple the produce, which will thus augment in a much larger proportion than the expenditure, and that up to a certain point, at which the produce will be as great as possible compared with the expendi-

ture. Past this point, if the expenditure be still increased, the produce will still increase, but less and less, and always less and less, until the fecundity of the earth being exhausted, and art unable to do anything further, an addition to the expenditure will add nothing whatever to the produce."

On the basis of this experience, which is confirmed by every farmer, it is customary to say that when successive doses of capital and labour are applied to land, increasing returns to each dose are first obtained, but that after a certain point of maximum returns has been reached, diminishing returns to each subsequent dose inevitably follow, unless an improvement is made in the methods of agriculture. Moreover, in old countries practically all the land has been worked at least as thoroughly as is necessary in order to reach the point of maximum returns; and it is therefore broadly true to say that, unless better methods of cultivation are used, *an increase in the capital and labour applied in the cultivation of land causes a less than proportionate increase in the amount of produce raised.* This statement is called the law of diminishing returns.

Against this tendency to diminishing returns in agriculture, out of which arises the danger of all the evils enumerated by Malthus, must be set another tendency which Mill called "the progress of civilization", in which he included every improvement in agricultural knowledge, in communications, in mechanical skill, and in social life. Such progress enables the world to support a vastly greater population than was possible in earlier days, and since the mere increase in numbers is itself a cause of progress, it is very difficult to say whether the average citizen would or would not have been better off if the population had increased less rapidly.

The tendency to diminishing returns was hidden during the latter half of the nineteenth century by the immense agricultural developments in America and the corresponding growth of the transatlantic transport. Now, however, that America is filling up and consuming an ever-increasing proportion of the food she grows, the question of Europe's food-supply is again attracting attention, and many economists are inclined to welcome the declining birth-rate as the only alternative to a permanent lowering of the European standard of life.—BIBLIOGRAPHY: Bonar, *Malthus and his Work*; C. E. Stangeland, *Pre-Malthusian Doctrine of Population*; W. S. Thompson, *Population: A Study in Malthusianism.*

Porbandar, a native state and town of India. The state extends along the south-western coast of Kathiawar Peninsula, and is in the province

of Bombay. Limestone (Porbandar stone) is extensively quarried. The chief (*rānā*) is a Hindu of the Jewtha clan of Rājputs, and belongs to one of the oldest races in India. Porbandar, on the shore of the Arabian Sea, is the seaport-capital and the terminus of the railway from Rājkot. The bar prevents craft of more than 80 tons burden from using the port. Porbandar is said to have been called *Sudāmāpuri* in ancient times. It became the state capital in 1785, when Sultānji made it his administrative centre. State area, 636 sq. miles; pop. (mainly Hindus), 91,000; (town), 25,000.

Por'beagle, a fish of the Lamnidæ family of sharks. Three species have been described; the best known is *Lamna cornubica*, which occurs in the North Atlantic, and frequently strays to the British coasts. It attains to a length of 10 feet, and is extremely voracious. The porbeagle has two dorsal fins, a wide mouth, lanceolate teeth, and very wide gill-openings.

Porcelain Crab (Porcellana), a name for certain crustacea, typical of the family Porcellanidæ, small flat crabs, of which two are British: *P. platychêles*, the hairy-clawed, and *P. longicornis*, the long-horned, porcelain crab. They live under stones.

Porch, an exterior appendage to a building, forming a covered approach to one of its principal doorways. The porches in some of the older churches are of two stories, having an upper apartment to which the name *parvis* is sometimes applied.—*The Porch* was a public portico in Athens (the *Stoa Poikile*) where the philosopher Zeno taught his disciples. Hence *The Porch* is equivalent to the *School of the Stoics*.

Por'cupine, a name of certain rodent mammals, the best-known species of which belong to



Crested Porcupine (*Hystrix cristata*)

the genus *Hystrix*, which is the type of the family Hystricidæ, including ground forms native to the Old World. The body is covered, especially on the back, with the so-called *quills*, or dense, solid, spine-like structures, intermixed with

bristles and stiff hairs. The muzzle is generally short and pointed, the ears short and rounded. The anterior feet possess four and the hinder feet five toes, all provided with strong, thick nails. The common or crested porcupine, *Hystrix cristata*, found in Southern Europe and in Northern Africa, is the best-known species. When fully grown it measures nearly 2 feet in length, and some of its spines exceed 1 foot. Its general colour is a grizzled dusky black. The spines in their usual position lie nearly flat, with their points directed backwards; but when the animal is excited they are capable of being erected. The quills are loosely inserted in the skin, and may, on being violently shaken, become detached—a circumstance which may probably have given rise to the purely fabulous statement that the animal possessed the power of actually ejecting its quills like arrows or darts at an enemy. These animals burrow during the day, and at night search for food, which consists chiefly of vegetable matter. Of the American species, constituting the family Cereolabidae, the Canadian or North American porcupine (*Erethizon dorsatus*) is the best known. It is about 2 feet long, and of slow and sluggish habits. The quills in this species are short, and are concealed amongst the fur. The ears are short, and hidden by the fur. The tail is comparatively short. The genus *Cereolabes* of South America possesses a distinctive feature in the elongated prehensile tail, adapting it for arboreal existence. These latter forms may thus be termed 'tree porcupines'. In length the typical species of this genus averages $1\frac{1}{2}$ feet, the tail measuring about 10 inches.

Porcupine Crab (Lithôdes), the name given to several extremely spiny species of crab. *L. maia* is common in the North Atlantic, and is variously known as the northern stone-crab and the devil-crab. *L. hystrix* is native to the Japanese seas.

Porcupine-fish (species of Diodon), fishes of the ord. Plectognathi, found in the tropical seas. They are about 14 inches long, and covered with spines or prickles.

Porcupine-grass (*Triodia* or *Festuca irritans*), an excessively spiny Australian grass which makes large areas almost impassable; also commonly called *spinifex*.

Pordenone, Il, Venetian painter, born in 1483, died in 1539. He is sometimes wrongly called Licinio. His family name was Sacchi, and he usually called himself Pordenone, from his native town in Friuli. He executed many works for his native place; some also for Mantua, Vicenza, and Genoa; but his greatest works were for Venice. Specimens of his works are to be found in many of the principal galleries of Europe.

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Porgie (*Pagrus vulgaris*), a fish of the family Sparidae, with an oblong body, scaly cheeks, and one dorsal fin, found off the coasts of the United States. It is one of the most important food fishes, and attains a length of 18 inches and a weight of 4 lb. The name is also given to the Menhaden (q.v.).

Porism, a kind of geometrical proposition with which Greek geometers took a good deal to do, but the nature of which is not known for certain, no books of porisms having come down to us. The generally accepted explanation of the word is that given by Playfair, viz. "a proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate, or capable of innumerable solutions". A simple example would be the problem of drawing a plane triangle with angles of m , n , and p degrees. Unless $m + n + p = 180$, there is no solution; but if this condition is fulfilled, there is an infinite number. Again, given two circles of radii R and r , R the greater, with their centres at distance d , it may be proposed to draw a triangle inscribed in the one and escribed to the other. If $d^2 = R^2 - 2Rr$, there is an infinite number of solutions; if d^2 and $R^2 - 2Rr$ are not equal, the problem is impossible.

Pork, the flesh of swine, is one of the most important and widely used species of animal food. Pork is coarser and ranker than beef or mutton, but when of good quality and well cured, it develops a richness and delicacy of flavour in marked contrast with the dryness and insipidity of other salted meat. The abundance and digestive quality of its fat renders it a suitable diet for cold climates. The swine was forbidden to be eaten by the Mosaic law, and is regarded by the Jews as especially typical of the unclean animals. Other Eastern nations had similar opinions as to the use of pork. Pork contains less fibrine, albuminous and gelatinous matter than beef or mutton.

Porogamy, in Flowering Plants, the normal type of fertilization, in which the pollen-tube penetrates to the ovum through the micropyle; opposed to *chalazogamy* (q.v.). See *Ovule*.

Porphyrio, a genus of birds of the rail family, including the *P. hyacinthinus* (purple or hyacinthine gallinule), a bird found in Europe, Asia, and Africa, and remarkable for the structure of its beak and the length of its legs. It feeds on seeds and other hard substances, and lives in the neighbourhood of water, its long toes enabling it to run over the aquatic plants with great facility. It is about 18 inches long, of a beautiful blue colour, the bill and feet red.

Porphyry (Porphyrios), Neo-Platonist philosopher, born at Batanea, in Syria, in 233, died in 304. His original name was Malchus (king).

He studied under Longinus at Athens, and at the age of thirty placed himself under the teaching of Plotinus at Rome. About 268 he went to Sicily, where he is said to have written his treatise against the Christians, which was publicly burned by the Emperor Theodosius, and is only known from fragments in the authors who have refuted him. Porphyry recognized Christ as an eminent philosopher, but he charged the Christians with corrupting his doctrines. In some of his works he dealt with speculative philosophy, but the majority were devoted to the history of philosophy. The most important of those extant are his *Life of Plotinus* and *Life of Pythagoras*.

Porphyry (Gr. *porphyreos*, purple), an igneous rock with a compact ground through which crystals of another tint are scattered, so as to give it a speckled aspect. The original type was the purple-red *antique porphyry* (the *porfido rosso antico* of the Italians), quarried by the Romans, but not by the Egyptians, at Jebel Dukhan, in the eastern desert of Egypt. It is an altered andesitic lava, with small white, yellowish, or pinkish feldspars in a deep pink ground, the colour being due to manganese silicates. The name porphyry became transferred to rocks of other colours with a similar structure, and geologists now apply the term *porphyritic* to any igneous rock in which larger crystals are set in a ground of smaller ones, or even in a glass. The green porphyry of Greece, coloured by epidote, was used by the Romans; but polished columns, vases, and slabs of the 'imperial' red porphyry found especial favour. The sarcophagi of Nero and Hadrian were made of this very handsome rock. A porphyry with large grey-green labradorite feldspars in a dark-green ground forms a considerable part of Lambay Island, off the Dublin coast.

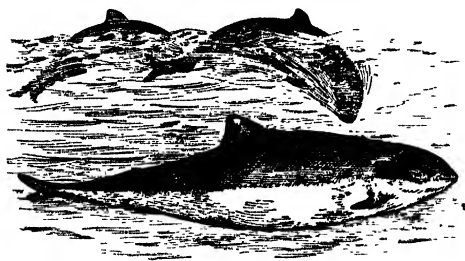
Porpoise, a genus of cetacean mammals, belonging to the family Delphinidæ (dolphins,

in the North Sea. It attains an average length of 5 feet. The front of the head is convex in form, and has the spiracle or blow-hole in the middle line. The eyes and ears are small. The caudal fin is horizontal and flattened. The neck is very short. The fore-limbs project from the body. No hind-limbs are developed. The teeth are small with blunted crowns. The stomach is in three portions. The porpoise feeds almost entirely on herrings and other fish, and herds or 'schools' of porpoises follow the herring-shoals, amongst which they prove very destructive. An allied species is the round-headed porpoise, or 'caaing whale' of the Shetlanders. These latter measure from 20 to 24 feet in length, and are hunted for the sake of the oil. See *Caaing Whale*.

Por'pora, Niccolò Antonio, Italian composer, was born at Naples about 1685, died there in 1767. His first opera, *Ariana e Teseo*, was produced at Vienna in 1717. In 1725 he went to Vienna, and subsequently paid professional visits to Rome, Venice, and Dresden. In 1729 a party in London, which was discontented with Handel, opened a second opera-house, and called Porpora to take the direction of it. Porpora was successful, and Handel after a heavy pecuniary loss gave up the theatre, and devoted himself to oratorio. Porpora afterwards returned to the Continent, and died in great poverty at Naples.

Porsen'na, or **Por'sena**, Lars, the king of the Etrurian city Clusium, according to the legend narrated by Livy, who received the Tarquins when they were expelled from Rome, and after in vain endeavouring to effect their restoration by negotiation, advanced with an army to Rome. He was checked by Horatius Cocles, who defended the bridge over the Tiber leading to Rome.

Porson, Richard, English classical scholar, was born in 1759, and died in 1808. His father was parish clerk at East Ruston, in Norfolk, and the curate of the parish made himself responsible for Porson's early education, having perceived in him signs of unusual ability. A neighbouring squire of the name of Norris (founder of the Norrisian professorship of divinity at Cambridge) took an interest in the boy, and, finding he was too old to be entered at the Charterhouse, sent him to Eton, where he remained from 1774 to 1778. He went up to Trinity College, Cambridge, in 1778, became a scholar of the college in 1780, and Craven scholar in 1781. In 1782 he graduated B.A., being third in the second class (senior optimes) of the mathematical tripos. In the same year he was awarded the first chancellor's medal, and was elected a Fellow of Trinity. His reputation became European after his publication of



Porpoises (*Phocaena communis*)

&c.). The common porpoise (*Phocaena communis*) is the smallest and most familiar of all Cetacea, and occurs plentifully off the British coasts and

Short Notes upon Toup's Emendations of Suidas (1790). In 1787 he wrote a series of three sarcastic letters to *The Gentleman's Magazine*, ironically eulogizing and at the same time parodying Hawkins's pompous *Life of Dr. Johnson*; and in the next year he contributed to the same periodical his *Letters to Archdeacon Travis*, in which he finally disposed of all claims of *1st John*, v, 7 (the three heavenly witnesses) to be authentic. In 1792 he vacated his fellowship (which was only tenable by a layman for seven years after taking the M.A. degree) rather than take holy orders, as he was not prepared to subscribe the Thirty-nine Articles. In the same year he was elected regius professor of Greek at Cambridge, with a salary of £40 a year. He only accepted the post when he found that ordination was not required. In 1795 he edited the plays of Æschylus for the Foulis press at Glasgow, and between 1797 and 1801 he edited four plays of Euripides—*Ileuba*, *Orestes*, *Phænissæ*, and *Medea*. He married in 1796, but his wife died of a decline five months later. His health began to fail about 1804; in 1806 he was appointed librarian to the London Institution. He was struck down with apoplexy in the Strand on 19th Sept., 1808, and died six days later. Towards the end of his life he had become a heavy drinker, and there is no doubt that his habits shortened his life and decreased his powers of working.

Porson was not merely one of the greatest, if not the greatest, of English classical scholars; he was a man of wide general reading, and was richly endowed with dry humour and caustic wit. His adaptation of an epigram of Phocylides still gives an unholy joy to those who do not admire Teutonic scholarship:

The Germans in Greek
Are sadly to seek;
Not five in five score,
But ninety-five more;
All, save only Hermann,
And—Hermann's a German.

This is his neat rhymed Latin epigram upon four prolific poetasters of his day:

Poetis nos lætatur tribus,
Pyc, Petro Pindar, Parvo Pybus.
Si ulterius ire pergus
Adde his Sir James Bland Burges.

Among his favourite English authors were Shakespeare, Milton, Dryden, Pope, Richardson, Smollett, and Swift. He had not a little of Swift's cutting humour; for example, he wrote to the master of Trinity about the Greek professorship that "if the place remains a sinecure, the number of qualified persons will be greatly increased". As a scholar Porson was chiefly celebrated for his textual criticism. His emendations were numerous, brilliant, and

convincing. His services to Æschylus, Aristophanes, Euripides, and Athenæus were especially conspicuous. His mathematical training helped him to attain clearness and accuracy in his scholarship. He had an invincible love for the truth, and his chief objection to entering the Church was that he found he would require about fifty years' reading to satisfy his mind on all points. The Porsonian tradition dominated classical scholarship at Cambridge for more than half a century after Porson's death; even still there are traces of it to be found. Porson's methods, in the hands of men who had none of his genius, and less than none of his humour, were apt to become somewhat dry and stereotyped. Scholarship of this kind became too narrow to be of educational value to the ordinary man; professional scholars before long evolved different methods of work, based upon a deeper knowledge of the comparative values of manuscripts. There is nothing discreditable to Porson in these facts, however; he was a great pioneer, and added greatly to scholarship by clearing up many points of Greek idiom, by inaugurating the methodical study of Greek metres, and by making brilliant emendations.

No account of Porson, however brief, would be complete without some reference to his wonderful hand-writing, which was, unlike that of most men of genius, almost perfect. It was small, in some cases almost microscopic, but exquisitely neat. The Greek type which is commonly in use in Great Britain was originally based upon Porson's hand-writing.

Port Adelaide, the chief seaport of South Australia, the port of the city of Adelaide, with which it is connected by rail (7½ miles). It is on the estuary of the Torrens, which enters the Gulf of St. Vincent. The harbour accommodates all ocean-going steamers, and is a port of call for all mail steamers. Cereals are exported. Pop. (1921), 30,116.

Portadown, a market town, railway centre, and river-port of County Armagh, Ireland, on the Bann (navigable to vessels of 90 tons); served by the Great Northern Railway, and the junction of the lines to Clones, Dublin, and Omagh. It has manufactures of linen and cambric, and a brisk trade in agricultural produce. Pop. about 11,000.

Portage la Prairie, a town of Manitoba, Canada, on the Assiniboine; served by the transcontinental railways. It is the centre of an opulent wheat-producing area, and has a large trade in cereals. Pop. about 6000.

Portal Circulation is a subordinate part of the venous circulation. The venous blood from the intestines and some of the abdominal organs is carried into the portal vein, and carried by that vessel to the liver, where it is distributed.

It is then gathered again into the hepatic veins and passes into the general venous circulation. A similar distribution occurs in the kidneys, and is known as the renal circulation.

Port Arthur, a city, lake-port, and railway centre of Ontario, Canada, on Thunder Bay, Lake Superior; served by the Canadian Pacific and National Railways. It is a lake terminus of the Canadian National Railway, and was formerly a terminal of the Canadian Pacific. Mining and lumbering are carried on. There are huge grain-elevators, and a large trade. Pop. (1921) 18,500.

Port Arthur, a fortified seaport of Manchuria, at the southernmost extremity of the Liao-tung Peninsula. Port Arthur is an out-station of the Chinese customs district, which has its headquarters at Dairen. The port is ice-free throughout the year, and is protected by a breakwater 1000 yards long. The South Manchuria Railway Company controls the sheds and warehouses. This railway connects Port Arthur and Dairen with Mukden, Kharbin, and the Chinese Eastern Railway system. Pop. 14-15,000.

Originally a Chinese fortress and arsenal, Port Arthur was captured by the Japanese under Oyama in 1894, but was restored to China under pressure by the Great Powers. By an agreement dated 27th March, 1898, the fortress and the adjacent port of Talien-wan (Dalny or Dairen) were leased to Russia, and Port Arthur was fortified by that country as the eastern base for her naval forces. During the Russo-Japanese War (1904-5) Port Arthur was invested by the Japanese by land and by sea, and was surrendered by General Stoessel on 2nd Jan., 1905. Japan gained the town by the Treaty of Portsmouth (New Hampshire), and a further lease of ninety-nine years was granted by China in 1915. See *Japan*.

Port Augusta, a seaport of South Australia, at the head of Spencer Gulf. It is the headquarters and the southern terminal of the transcontinental lines to Oodnadatta and Kalbarrie. There is a cathedral, and Port Augusta is the see of a Roman Catholic archbishop. Ostrich-farming is carried on in the neighbourhood, and the port is the natural outlet for the vast wool-producing pasture-lands of the South Australian hinterland, and for mine products of gold, silver, copper, coal, and iron. Pop. about 1500.

Port-au-Prince, the capital and seaport of the Republic of Haiti, West Indies. There is an excellent harbour, which maintains a large transit trade in hides, coffee, and other national products. There is a cathedral. The town was first laid out in 1749, and has twice been destroyed by earthquakes. Pop. 120,000.

Port Blair, a penal settlement in the Andaman Islands, Bay of Bengal, consisting of the

South Andaman and adjacent islands; area, 473 sq. miles. Port Blair, on the east coast of South Andaman Island, is the capital and chief seaport, the administrative centre of the penal settlement being on Ross Island, which lies across the entrance to the magnificent harbour. On Ross Island there is a lighthouse with a visibility of 19 miles. Wireless telegraphy between Port Blair and Diamond Island, off the coast of Burmah, has been worked successfully since 1905. The town is garrisoned by British and native (Indian) infantry. Communication is afforded by mail steamer with Madras, Calcutta, and Rangoon. Pop. of penal settlement (1921), 11,532 convicts (373 being women); civil and military pop. (1921), 15,713.

Porte, **Ottoman**, or **Sublime Porte**, the common term for the Turkish Government. The chief office of the Ottoman Empire is styled *Babi-ali*, literally the High Gate, from the gate (*bab*) of the palace at which justice was administered. The French translation of this term is *Sublime Porte*, and has been adopted in the English language.

Port Elizabeth, a seaport of Cape Province, South Africa, on Algoa Bay, the fifth South African city in point of size, and a great emporium of trade for the eastern section of the colony. The port is owned and administered by the State, and is sometimes known as 'the Liverpool of South Africa'. Pop. (1921), 45,927, 25,940 being white.

Bartholomew Diaz discovered Algoa Bay in 1488, and named it Bahia de Roca. During the sixteenth century it became known as the Bahia de Lagoa, from which the present name is derived. In 1799 Colonel Vandeleur built a fort, which he called Fort Frederick, in honour of the Duke of York, and round this fort the settlement of Port Elizabeth had its beginning.

Porteous Riot, an incident in Scottish history, originating in the fact that in 1736 Captain John Porteous, a commander of the Edinburgh City Guard, fired on a mob, killing and wounding a number. For this he was tried and condemned to death, but was subsequently reprieved. On the night of 7th Sept., however, a number of persons dragged him from the Tolbooth, where he was confined, to the Grassmarket, and hanged him there. None of those concerned were ever brought to justice, and the only satisfaction secured by the law was the fining of the city of Edinburgh in £1500, for the benefit of Porteous's widow, and disqualifying the Lord Provost from again holding office. The incident is dealt with in Scott's *Heart of Midlothian*.

Porter, Jane, novelist, born at Durham in 1776, died in 1850. Educated at Edinburgh, she spent most of her life with her mother and

sister in or near London. Her first work (1803) was *Thaddeus of Warsaw*, a highly popular historical romance, and a still greater success attended *The Scottish Chiefs* (1809). She also wrote *The Pastor's Fireside*, and *Sir Edward Seaward's Narrative of his Shipwreck*, a piece of fiction which she claimed to have edited.

Port Erin, a watering-place of the Isle of Man, on Port Erin Bay; served by rail from Douglas (15 miles). The massive breakwater of the harbour is in ruins. There is a piscicultural station and a marine biological station. Golf-links and sea-bathing provide attraction for tourists. Pop. 3200.

Port Glasgow, a municipal and police burgh and seaport of Renfrewshire, Scotland, on the Firth of Clyde; served by the Glasgow-Gourock branch of the Caledonian Railway. The town nestles at the foot of a massive slope 700 feet in height. There are several fine buildings, but the principal features of the town are the shipyards and their coadjutors in iron-founding and engineering, and the extensive port which was originally what the name implies, the port of Glasgow. Near by are the ruins of Newark Castle, a sixteenth-century keep that was once a stronghold of the Dennistouns.

In 1668, when the Clyde was easily fordable where it now gives passage to transatlantic liners, a piece of land was purchased from the Maxwells by the magistrates of Glasgow, and a harbour was constructed, the resulting settlement being erected into a separate parish in 1695 as New Port Glasgow. In 1762 the first graving-dock in Scotland was added to the harbour equipment. Port Glasgow became a burgh of barony in 1775, but, with the erection of Glasgow into a first-class seaport, its maritime trade gradually declined and is now comparatively insignificant. It is one of the Kilmarnock parliamentary burghs, uniting with Kilmarnock, Rutherglen, Dumbarton, and Renfrew in sending a member to Parliament. Pop. 21,000.

Port Harcourt, a seaport of Nigeria, on a creek of the Bonny and New Calabar Rivers; the seaward terminal of the eastern railway system of Nigeria. A cliff rises to a height of over 40 feet, and alongside this there is a water-depth of over 50 feet. The port is named after Lewis Harcourt (Viscount Harcourt), who was Colonial Secretary when it was discovered. See *Nigeria*.

Port Huron, a city and port of entry of Michigan, United States, the county seat of St. Clair county, on the St. Clair River where it leaves Lake Huron; served by the Grand Trunk and other railways, and by inter-port steamboats to Chicago, &c. The railway passes by a tunnel (6000 feet) under the St. Clair to

Sarnia, in Canada. It has an extensive lumber trade, railway workshops, shipyards, saw-, flour-, and planing-mills.

Port Huron originated in Fort St. Joseph, established by the French in 1686. As a village it was laid out in 1790, and was called La Rivière de Lude. In 1828 it became Desmoud, and was incorporated as a city under its present name in 1857. Pop. (1920), 25,944.

Portici (por'ti-chê), a town of Campania, Southern Italy, in the province of Naples, on the Gulf of Naples at the base of Vesuvius. It is about 5 miles east of the city of Naples, but is connected with it by the long village of S. Giovanni a Teduccio. An active fishery is carried on. Pop. 14,400.

Portishead, familiarly *Posset*, a watering-place of England, in Somersetshire, on the Severn estuary; served by the Great Western Railway. The dock covers 12 acres, and belongs to the Port of Bristol. Pop. 3300.

Port Jackson, an extensive inlet on the coast of New South Wales, forming a well-sheltered harbour. Sydney lies along the southern shore. The inlet is island-studded, has a good depth of water in every part, and is the fortified base of the Australasian naval forces. Port Jackson was discovered by Captain Philip in 1788, but was named by Captain Cook in 1770, who had passed the towering North and South Heads without noticing the vastness of the harbour to which they act as sentinels and shelters. See *Sydney*.

Portland, a city and port of entry of Maine, United States, the county seat of Cumberland county, on a peninsula at the western extremity of Casco Bay; served by the Maine Central, Boston & Maine, and Grand Trunk Railways, and by transatlantic steamers and coasting vessels (to New York, St. John, N.B., and Boston, &c.). Locomotives, cars, &c., are made; there are also shipbuilding yards, glassworks, potteries, and rope-walks; and the refining of petroleum and sugar is extensively carried on. Portland is the largest city of Maine, and is connected by ferry with South Portland. The harbour is fortified, and is easy of access, capacious, safe, deep enough for the largest vessels, and rarely obstructed with ice; hence it is a convenient winter port for traffic between Britain and Canada. The principal exports are timber, fish, beef, and butter.

Portland originated in the settlement of Falmouth (1718), which became a town in 1786. In 1832 it became a city, having been state capital until that time (1820-32). Pop. (1920), 69,196.

Portland, a city and port of entry of Oregon, United States, the county seat of Multnomah county, on the left bank of Willamette River;

served by the Canadian Pacific, Northern Pacific, Southern Pacific, and Great Northern Railways, and by transpacific steamers from China and Japan, &c., and coastwise to San Francisco and British Columbian ports. Portland is the largest town in Oregon, and has a Protestant Episcopal cathedral, Columbia University (Roman Catholic), law and medical faculties of the University of Oregon, and a military academy. The harbour is extensive, and handles fish (salmon especially) and the timber, cereals, and fruit of the Willamette and Columbia Valleys. As a manufacturing centre Portland is the metropolis of the state, lumber and timber products, flour, tinned salmon, and cordage being among the principal items. Railway rolling-stock is also repaired. Portland was founded in 1845, and became a city in 1851. Pop. (1920), 258,288.

Portland, Isle of, a peninsula, supposed to have been formerly an island, in the county of Dorset, 50 miles w.s.w. of Southampton, in the English Channel. It is attached to the mainland by a long ridge of shingle, called the Chesil Bank, and it consists mainly of the well-known Portland stone, which was chiefly worked by convicts from the convict prison. Farming, sheep-rearing, fishing, &c., are carried on. The south extremity of the island is called the *Bill of Portland*, and between it and a bank called the Shambles is a dangerous current called the *Race of Portland*. Pop. 17,000. See *Portland Breakwater*.

Portland Beds, in geology, a division of the Upper Jurassic series occurring between the Purbeck Beds and the Kimmeridge Clay, consisting of beds of hard oolitic limestone and freestone interstratified with clays and resting on light-coloured sands which contain fossils, chiefly mollusca and fish, with a few reptiles. They are named from the rocks of the series forming the Isle of *Portland*, in Dorsetshire, whence they may be traced through Wiltshire as far as Oxfordshire. The continental Portlandian stage is on the same horizon.

Portland Breakwater, the greatest work of the kind in Britain, runs from the north-east shoulder of the Isle of Portland in a north-east direction, with a bend towards the English Channel, and is continued by two new breakwaters extending towards Weymouth, complete protection thus being given to a large expanse of water, and a great harbour of refuge being provided. The original work consists of a sea-wall 100 feet high, 300 feet thick at the base, and narrowing to the summit, and has a length of $1\frac{1}{2}$ miles, consisting of two portions, one connected with the shore, 1900 feet in length, and another of 6200 feet in length, separated from the former by an opening 400 feet wide, through which ships can pass straight to sea. It is pro-

tected by two circular forts, the principal at the north end of the longer portion. The work, which was carried out by Government, occupied a period of nearly twenty-five years, ending with 1872, and cost £1,033,600, exclusive of convict labour. The new breakwater, which is in two sections each about 4500 feet long, extends from the shore near Weymouth to a point about 700 feet from the older structure. The whole work encloses an area of over 2000 acres of water, three-quarters of it over 30 feet deep at low water.

Portland Cement. See *Hydraulic Cement*.

Portland Stone, is an oolitic limestone occurring in great abundance in the Isle of Portland, England. It is one of the members of the Portland Beds, and is much used in building, being soft when quarried, but hardening on exposure to the atmosphere. St. Paul's Cathedral, London, is built of it.

Portland (or Barberini) Vase, a celebrated ancient cinerary urn or vase, of the third century



The Portland Vase

after Christ, found in the tomb of the Emperor Alexander Severus. It is of transparent dark-blue glass, coated with opaque white glass, which has been cut down in the manner of a cameo, so as to give on each side groups of figures delicately executed in relief, representing the marriage of Peleus and Thetis. In 1810 the Duke of Portland, its owner, allowed it to be placed in the British Museum, where it remained intact till the year 1845, when it was broken by a madman. The pieces were carefully collected and very successfully reunited, and in this state it still remains in the museum, and is exhibited to visitors. The vase was frequently copied by Wedgwood.—Cf. J. Wedgwood, *The Portland Vase*.

Port-Louis, or Isle de France, the capital of the Island of Mauritius, on the north-west

coast, beautifully situated in a cove formed by a series of basaltic hills, partially wooded, varying in height from 1058 to 2639 feet. The site is rather unhealthy. A mountain stream traverses the town, and an open space like a racecourse lies behind it. There are barracks, theatre, public library, two observatories (astronomical and meteorological), botanic garden, hospital, and Anglican and Roman Catholic cathedrals. The town and harbour are highly fortified. Exports are principally sugar, coconut oil, and fibre. In recent years the greater part of Port-Louis has passed from European to Indian and Chinese hands. Pop. (1920), with suburbs, 39,300.

Port-Mahon (Roman *Portus Magonis*), a Spanish naval station and seaport, the capital of the Island of Minorca, situated on a narrow inlet in the south-east of the island. The harbour, protected by strong forts, is one of the finest in the Mediterranean, and an important trade is carried on.

As *Portus Magonis* Port-Mahon was a *municipium*. Under James Stanhope (later Earl Stanhope) the island was seized in 1708 by the British, and Port-Mahon became a flourishing city. In 1718 it became a free port, but fell to the French in 1756 through Admiral Byng's failure to raise the siege of San Felipe. In 1802 it was ceded to Spain (Treaty of Amiens). Pop. 18,000.

Port Moresby, the capital and chief seaport of the Australian dependency of Papua, on the south coast of the Island of New Guinea. There is a wireless station, and communication with Sydney is maintained by steamer. Near Port Moresby a large mineral-field of promising copper deposits is being vigorously developed, and a railway connects it with the coast. The capital is the seat of the supreme court. Pop. 3000.

Port Nolloth, a port of Little Namaqualand, South-West Africa. It is the seaward terminus of a light railway running through the hills for about 50 miles to Steinkopf, where it turns south to O'okiep, a copper-mining centre. It is served by steamer from Cape Town. The climate is exceedingly dry, and water has to be transported in tank-cars by the railway from holes some 5 miles distant in the hinterland. Port Nolloth was the scene of the opening of General Botha's campaign during the European War, when, in Sept., 1914, the first of the Union forces arrived from Cape Town. The hinterland is very hilly and rough, and almost wholly waterless. Pop. about 1500.

Porto Alegre, a city and seaport of Brazil, capital of the state of Rio Grande do Sul. There is a commodious harbour. Porto Alegre is the seat of a Roman Catholic bishop, and, as a

consequence, there is a cathedral. There are many educational establishments. An extensive transit trade is carried on, and Porto Alegre is considered the chief manufacturing town of the state, producing macaroni, preserves, soap, candles, leather goods, iron goods, cotton fabrics, dairy produce, and furniture. There are also shipyards, used for the construction of lake and river vessels. Pop. (1913), 150,343.

Port of Spain, the chief town and seaport of the Island of Trinidad, West Indies, on the east coast. It is a wireless station, and is a port of call for ocean-going steamers and many coasting lines. There are Anglican and Roman Catholic cathedrals, botanic gardens, and a royal college. It is a railway terminus, and has electric tramways, telephones, &c. Cocoa and sugar are the chief exports. Pop. 70,146.

Porto Maurizio, a maritime frontier province of Liguria, Italy, traversed by spurs of the Ligurian and Maritime Alps. All the chief towns of the Italian Riviera are in Porto Maurizio. The coastal railway from Nice to Genoa and the line from Ventimiglia to Cuneo serve the province. Olives and oil, fruits and flowers are the principal products. Porto Maurizio is the capital. Area, 456 sq. miles; pop. (1915), 149,629.

Porto Maurizio, a seaport-city of Italy, capital of the province of Porto Maurizio; served by the railway from Nice (46 miles) to Genoa (70 miles). The city is united with Oneglia as a commune, and both are famed for their olives and the quality of the oil they produce. They are also watering-places of some note, and are much frequented for sea-bathing. Pop. (commune), 8039.

Porto Novo, a town and port of India, in the South Arcot district of Madras, at the mouth of the Vellar River; served by the trunk line of the Madras-Tuticorin Railway. The English settlement was established in 1683, but the Portuguese had founded here, in the latter part of the sixteenth century, the first European settlement on the Coromandel coast. Haidar Ali plundered the town in 1780, but a speedy retribution followed when (July, 1781) he was caught outside the town and decisively defeated by Sir Eyre Coote. Pop. about 6000.

Porto Rico, one of the larger West Indian Islands, the smallest but most densely peopled of the Greater Antilles. It lies to the east of Santo Domingo (Haiti), from which it is separated by the Mona Passage.

Physiography.—The interior of the island is an elevated plateau, traversed from west to east by several low, wooded ranges which culminate in the Peak of El Yunque (4985 feet altitude). This range descends abruptly to the

sea on all sides, but there are coastal plains of limited extent on the northern and southern seaboard. There are few indentations that provide safe harbourage, and all rivers are rapid and practically unnavigable. *Climate*.—The climate is fairly healthy, for the island lies in the region of the 'north-east trades'. The average annual temperature varies between 78° and 82° F., falling to 56° in winter, and rising to 100° F. in summer. Hurricanes and cyclones are prevalent. Area, 3606 sq. miles.

People.—The inhabitants are decidedly mixed, varying in colour from pure white, through all the shades of yellow and brown, to jet black. In 1920 the total population was returned as 1,299,809 (377·8 per square mile). According to colour, this was distributed as follows: white, 948,709; black, 49,246; mulatto, 301,816; Chinese, 32; Japanese, 4; all others (Filipino and Hindu), 2. During the inter-censal period (1910–20) the white population increased by about 30 per cent, the black decreasing by 2 per cent, and the mulatto by 10 per cent.

Education.—School attendance has been compulsory since 1899. The University of Porto Rico is located at Rio Pedras, near San Juan, and accepts students of both sexes.

Production and Commerce.—63 per cent of the people of Porto Rico are engaged in agriculture, fisheries, and mining; 21 per cent in domestic and personal services; 8 per cent in manufacturing industries; and 8 per cent in trade and transport services. The higher slopes of the hills are still covered with the remains of the primeval forests with which the island was once entirely covered, but the forests have in great part given place to coffee-bushes, sugar-cane, tobacco, and other plants of economic value. The mineral resources are negligible, but heavy deposits of phosphates exist on the north coast, and guano is found on Mona Island. Among the principal island products are: tobacco, sugar, coffee, fruits (pine-apples, coco-nuts, grape-fruit, and oranges), sea-island cotton, sisal and other textile fibres, guano, phosphate, and vegetables. Manufactures consist chiefly of cigars, cigarettes, huts, and embroideries. Nine-tenths of the exports go to the United States, and roughly eleven-twelfths of the imports are received from or via that country.

Communications.—There are over 1000 miles of road in Porto Rico, and some 340 miles of railway, which encircles the coasts and also taps the hinterland from Rio Piedras to Caguas.

Towns.—San Juan is the chief port and naval station, and has an entrance 600 yards wide and 30 feet deep. Pop. (1920), 70,707. Other towns are Ponce (41,500) and Mayaguez (20,000).

Government.—Columbus discovered Porto Rico

in 1493, and it was conquered by Ponce de Leon in 1508, but received little attention from Spain until the rebellion of the native Indians in 1811, when they were practically extirpated by the conquerors. In April, 1898, war broke out between the United States and Spain, and the Americans took the island, which was ceded to them by the treaty of 10th Dec., 1898. The 'Organic Act' of Congress (Jones Act), passed in 1917, granted rights of American citizenship to the Porto Ricans. The Government is representative, the executive power being in the hands of a Governor appointed by the President of the United States, and the legislative power is vested in a legislature of two elective Houses. These are the Senate (19 members, 2 elected from each of the 7 senatorial districts and 5 Senators at large) and the House of Representatives (39 members, 1 from each of the 35 representative districts and 4 elected at large). A Resident Commissioner to the United States is elected by the people for a term of four years, and represents them in Congress. Six heads of departments form an advisory council (Executive Council) to the Governor.

Dependencies.—The Island of Vieques lies 13 miles off the east coast. It is 20 miles long and 6 miles broad, and produces cattle and sugar. Pop. 10,000. It is healthy and fertile. The Island of Culebra provides a good harbourage. It lies between Porto Rico and St. Thomas.

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Port-Patrick, a seaport of Wigtownshire, Scotland, on the Irish Sea, the nearest port in Britain to Ireland, the distance being only 21 miles. The town is connected with Stranraer (7 miles) by the Portpatrick and Wigtownshire Light Railway. Pop. (1921), 1495.

Port-Royal, a fortified port and naval station on the south-east coast of Jamaica, on a tongue of land forming the south side of the harbour of Kingston. Its harbour is the head-quarters in the West Indies for British ships of war, and it contains a naval dockyard, barracks, arsenal, and hospital. It has been often damaged by earthquakes. Pop. 1200.

Port-Royal, the name of a convent of the Cistercian or Bernardine nuns, and also of a school of theological thought. It became famous in the seventeenth century as the centre of the Jansenist controversy. It was situated near Chevreuse (department of Seine-et-Oise), about 15 miles s.w. of Paris, and was founded in 1204 by Matthieu de Montmorency, under the rule of St. Bernard. Port-Royal, like many other religious houses, had fallen into degenerate

habits, when in 1609 the abbess Jacqueline-Marie-Angélique-Arnauld undertook its reform. The number of nuns increased considerably under her rule, and in 1625 they amounted to eighty. The building thus became too small, and the insalubrity of the situation induced them to seek another site. The mother of the abbess purchased the house of Cluny, in the Faubourg Saint-Jacques, Paris, to which a body of the nuns removed. The two sections of the convent were now distinguished as Port-Royal des Champs and Port-Royal de Paris. About 1636 a group of eminent literary men of decided religious tendencies took up their residence at Les Granges, near Port-Royal des Champs, where they devoted themselves to religious exercises and the education of youth. These were regarded as forming a joint community with the nuns of Port-Royal, among whom most of them had relatives. Among the number were Antoine Arnauld, Arnauld d'Antilly, Le-maître de Sacy and his two brothers, all relatives of the abbess; Nicole, and subsequently Pascal, whose sister Jacqueline was at Port-Royal. The educational institution, thus founded, which flourished till 1660, became a powerful rival to the institution of the Jesuits, and as the founders adopted the views of Jansenius, subsequently condemned by the Pope, a formidable quarrel ensued, in which the Port-Royalist nuns, siding with their male friends, became subject to the relentless persecution of the Jesuits, which culminated in the complete subversion of their institution. Port-Royal des Champs was finally suppressed by a Bull of Pope Clement II (1709), and its property given to Port-Royal de Paris. The latter continued its existence to the Revolution, when its house was converted into a prison, and subsequently (1814) into a maternity hospital.—BIBLIOGRAPHY: Sainte-Beuve, *Port-Royal*; E. Romanes, *Story of Port-Royal*; M. E. Lowndes, *The Nuns of Port-Royal as seen in their own Narratives*; L. Rea, *Enthusiasts of Port-Royal*.

Portrush, the chief watering-place of the north of Ireland, in County Antrim; served by the Midland (Northern Counties) Railway, and by steamboats to English, Scottish, and Irish ports. It is connected with the Giant's Causeway (q.v.) by an electric tramway (7 miles). Near by are the ruins of Dunluce Castle, originally in possession of the M'Quillan family, but taken from them by the M'Donnells of the Isles in the sixteenth century. Randal, the son of Sorley Boye, was made Viscount Dunluce by James I. Pop. 2000.

Port Said, a town of Egypt, on the Mediterranean, at the northern entrance of the Suez Canal. It was begun simultaneously with the canal in 1859, being designed for its terminal

port. There is an outer harbour formed by two piers jutting out into the sea, each terminated by a small lighthouse. This admits large ocean steamers, which thus sail into the inner harbour and from it into the canal. Near the entrance to the inner harbour is a lofty lighthouse with a powerful light. Pop. including Ismailia (1917), 91,090.

Portsea, an island of Hampshire, England, about 5 miles long (north to south) by about 3 miles broad. It comprises the towns of Portsmouth and Portsea, and is connected with the mainland by a bridge at its north end. See *Portsmouth*.

Portsmouth, a municipal, county, and parliamentary borough, seaport and naval base of England, in Hampshire, on the south-west extremity of the Island of Portsea, which is separated from the mainland on the north by a narrow creek called Portsbridge Canal, is bounded on the east by Langston Harbour, on the west by Portsmouth Harbour—on the other side of which is Gosport—and on the south by Spithead roadstead. It consists of the five chief districts—Portsmouth proper, Portsea, Landport, Southsea, and Cosham. Portsmouth and Portsea are the seat of the naval dockyard; Landport is mostly an artisan quarter; and Southsea, on the east side of Portsmouth proper is a favourite seaside resort, commanding fine views of Spithead and the Isle of Wight beyond. Southsea Castle with its adjacent earthworks, the batteries of the Gosport side, and the circular forts built out in the roadstead command the entrance to Portsmouth Harbour. The northern, Cosham, area is mainly agricultural. The royal dockyard covers an area of about 500 acres, and is considered the largest and most magnificent establishment of the kind in the world. In connection with it there are hospitals, a naval college, torpedo range, and barracks. About 15,000 men are employed in the repair and refitting of naval vessels. The navy gunnery school and ranges are on Whale Island, within the harbour. Portsmouth dockyard existed as such in the fifteenth century, was definitely adopted as a base about 1540, and has been increasing both in size and importance from that date. Portsmouth has no manufactures of consequence, except those immediately connected with its naval establishments, and a few large breweries. Its coasting trade is of great extent. An extensive and systematic series of fortifications ensure the complete defence of the harbour works. They extend along a curve of about 1½ miles at the north side of Portsea Island. A series of hills, 4 miles to the north of Portsmouth, and commanding its front to the sea, is well fortified with strong forts. On the Gosport side a line

of forts extends for 4 miles. The county and parliamentary borough includes nearly the whole of the Island of Portsca. Pop. (1921), 247,343.

Portsmouth, a city and port of entry of New Hampshire, United States, one of the county seats of Rockingham county, on the Piscataqua; served by the Boston & Maine and electric traction railways. A Government navy yard is located on Shoal Island, within the harbour. It is officially called the Portsmouth Navy Yard, but is not included within the township. It is in Kittery, Maine, but Portsmouth is its port of entry. Portsmouth was founded in 1623, and (with Dover) is the oldest settlement in the state. It became a city in 1849, and was state capital from the constitution of New Hampshire as a province until 1775. Portsmouth is the only seaport in the state. The peace treaty between Japan and Russia was concluded there in 1905. Pop. (1920), 13,569.

Portsmouth, a city of Ohio, United States, the county seat of Scioto county, at the confluence of the Scioto and Ohio Rivers; served by the Baltimore & Ohio South-Western, the Chesapeake & Ohio, and the Norfolk & Western Railways, and by the Ohio & Erie (Portsmouth to Cleveland) Canal. Portsmouth is the metropolis of an agricultural, mining, and quarrying region. It was settled in 1803, and became a city in 1851. Pop. (1920), 33,011.

Portsmouth, a city of Virginia, United States, in Norfolk county, on the Elizabeth River directly opposite Norfolk; served by the Chesapeake & Ohio Railway, the Atlantic Coast Line, Seaboard Air Line, and electric traction lines. It is the seat of a United States navy yard (Norfolk Yard), one of the largest in the country, covering 450 acres. There are few manufactures, but the city is the centre of the Virginian oyster-fishery. In 1752 Portsmouth was settled, and the British Government founded the navy yard. In 1858 it became a city. Pop. (1920), 54,387.

Port Sudan, the principal seaport of the Anglo-Egyptian Sudan, on the Red Sea; served by a branch of the riverain railway from Atbara, which bifurcates at Hanbûk for Port Sudan and Suâkin. Gum, ivory, cotton, sesame, and much coal are among the goods handled at the port, which is also the head-quarters of the Sudanese customs administration. Port Sudan replaced Suâkin as the principal seaport in 1905.

Portugal, a republic in the south-west of Europe, forming the west part of the Iberian Peninsula; bounded east and north by Spain, and west and south by the Atlantic; greatest length, north to south, 345 miles; greatest breadth, 140 miles.

Extent.—The seven old provinces, Entre Minho-e-Douro, Traz-os-Montes, Beira (Upper

and Lower), Estremadura, Alemtejo, and Algarve, now form seventeen districts, as shown in the table overleaf. The Azores are divided into three districts, and Madeira forms one district. These islands are regarded as an integral part of the Republic.

Chief Towns (q.v.).

Town.	Pop. ¹	Town.	Pop. ¹
Lisbon	489,667	Covilhã	15,745
Oporto	203,981	Faro	12,680
Setubal	30,346	lavra	11,665
Funchal	24,687	Portalegre ..	11,603
Braga	24,647	Aveiro	11,523
Coimbra	20,581	Elvas	10,645
Evora	17,901	Castello	10,486
Ponta Delgada (Azores) ..	16,179	Beja	10,113

¹All 1911 except Lisbon and Oporto, for which the figures refer to 1920.

Physiography.—Portugal is only partially separated from Spain by natural boundaries. Its shape is nearly that of a parallelogram. The coast-line, of great length in proportion to the extent of the whole surface, runs from the north in a south-south-westerly direction till it reaches Cape St. Vincent, where it suddenly turns east. It is occasionally bold, and rises to a great height; but the greater part is low and marshy, and not infrequently lined by dangerous sands and reefs. The interior is generally mountainous, a number of ranges stretching across the country, forming a succession of independent river basins, while their ramifications form the watersheds of numerous subsidiary streams, and enclose many beautiful valleys. The loftiest range is the Serra d'Estrella, a continuation of the central chain stretching across Spain. The greater part of Portugal is occupied by ancient rocks of Archaean and Palæozoic age, and by eruptive masses which probably date from varying periods. *Rivers.*—No important rivers rise within the country. The principal rivers are the Douro, Tagus, and Guadiana, which are described separately. The Minho is the most northerly river, and is inferior in size only to those mentioned. *Climate.*—The climate is greatly modified by the proximity of the sea and the height of the mountains. In general the winter is short and mild, and in some places never completely interrupts the course of vegetation. Early in February vegetation is in full vigour; during the month of July the heat is often extreme, and the country assumes, particularly in its lower levels, a very parched appearance. The drought generally continues into September; then the rains begin, and a second spring unfolds. Winter begins at the end of November. In the mountainous districts

Home.			Dependencies.		
Districts and Provinces. ¹	Area in sq. Miles.	Population (1st Dec., 1911).		Area in sq. Miles.	Population.
Vianna do Castello	857	227,420	India—Goa	1,469	515,772
Braga	1,040	382,461	Damão	149	30,000
Porto	893	679,978	Diu	20	2,700
<i>Entre Minho-e-Douro</i>	2,790	1,289,859	Timor	7,330	377,815
Villa Real	1,650	245,687	China: Macao, &c.	4	74,866
Bragança	2,513	192,133	Total Asia	8,972	1,001,153
<i>Traz-os-Montes</i>	4,163	437,820	Africa—Cape Verde Islands ..	1,480	149,793
Aveiro	1,065	336,243	Guinea	13,940	289,000
Vizeu	1,937	416,860	Príncipe and São Thomé ..	360	58,907
Coimbra	1,508	360,056	Angola	484,800	4,119,000
Guarda	2,116	271,816	Mozambique	426,712	3,120,000
Castello Branco	2,582	241,509	Total Africa	927,292	7,736,700
<i>Beira</i>	9,208	1,626,484	Total Colonies	936,264	8,737,853
Lerria	1,317	262,558	Summary.		
Santarem	2,555	322,753			
Lisbon	3,065	853,415			
<i>Estremadura</i>	6,937	1,438,726			
Portalegre	2,405	141,778	Continent	34,254	5,545,595
Evora	2,856	144,307	Islands ²	1,236	412,390
Beja	3,958	192,499	Colonies	936,264	8,737,853
<i>Alemtejo</i>	9,219	478,584	Grand Total	971,754	14,695,838
<i>Algarve (Faro)</i>	1,937	274,122			
Total Continental	34,254	5,545,595			
<i>Islands:</i>					
Azores	922	242,613			
Madeira	314	169,777			
Total Insular	1,236	412,390			

² Madeira and the Azores are not considered as dependencies or colonies but as provinces of Portugal proper.

¹ The provinces are described under separate articles throughout this work.

the loftier summits obtain a covering of snow, which they retain for months; but south of the Douro, and at a moderate elevation, snow does not lie long. The mean annual temperature of Lisbon is about 56°.

Social Conditions: People.—The people are of very mixed blood—Basque, Celtic, Roman, Arabic, and even African. As is often typical of sea-faring people, the women distinctly outnumber the men—by eleven to ten. **Religion.**—Roman Catholicism is the predominant religious faith, but all denominations are tolerated, and there is absolute freedom. There are three archiepiscopal sees, Lisbon (seven suffragans), Braga (five suffragans), and Evora (two). The archbishopric of Braga is the oldest of Portuguese sees. The Azores, Madeira, São Thomé, Príncipe, and West African possessions generally are included in the ecclesiastical province of Lisbon, only two of the suffragans of that province being actually located on the mainland. **Education.**—Elementary education is free

and compulsory, and secondary and higher instruction are also provided. There are three universities, located at Lisbon, Oporto, and Coimbra respectively. A technical school (Lisbon) instructs in engineering, &c., and there are also commercial academics, a military academy (Lisbon), a naval college, and art and music institutions at Lisbon and Oporto. **Money, &c.**—By a decree of the Provisional Government (22nd May, 1911) the unit is the gold *escudo* of 100 *centavos*, worth normally 4s. 5½d. There are gold coins of 10, 5, and 2 *escudos*, silver pieces value 1 *escudo* and 50, 20, and 10 *centavos*, and bronze and nickel coins of 4, 2, 1, and ½ *centavo* respectively. The sovereign and half-sovereign (British) are accepted by law, and are respectively equivalent to 4½ and 2½ *escudos*. Legal time is based on the meridian of Greenwich. The metric system of weights and measures is the legal standard.

Communications.—The Lisbon-Badajoz Railway, opened in 1853, was the first railway in

Portugal, and, prior to 1851, there was not a carriage road in the state that was worthy of the name. Nowadays there are two State railways of 733 miles in length, and five private lines of 1314 miles. The total mileage was (1921) 2128. The standard gauge is 5 feet 5½ inches, but two lines have 3-feet-3½-inch and 2-feet-11½-inch gauges respectively. There are post office, telegraph, radiograph and telephone, inland and international services.

Production.—43 per cent of all land is waste; 26 per cent is cultivated for cereals, &c.; 4 per cent is under vineyards; 4 per cent under fruit-trees; and 19 per cent is afforested. For production, the country may be divided into four regions: *north*—producing maize and cattle; *south*—producing wheat and pigs; *central*—producing wheat and maize; *mountain*—producing rye, sheep, and goats. All these regions have vineyards and produce wine, the vintage amounting to over 90,000,000 gallons per annum. In addition, figs, tomatoes, oranges, onions, and potatoes are widely raised, and olive-oil is produced to the extent of 13,000,000 gallons per annum. Roughly, 800,000 acres are covered by olive trees. **Forests.**—Cork is a great source of Portuguese wealth, about 170,000,000 lb. being produced annually. About 817,000 acres are laid down to cork trees. Others are pine (1,900,000 acres), oak (900,000 acres), chestnut (211,000 acres), and Pyrenean oak (170,000 acres). **Minerals.**—Wolfram is the chief mineral; iron, manganese, copper, lead, tin, antimony, and gold are found. Coal is scarce, and transport conditions do not encourage the exploitation of known deposits. **Fisheries.**—40,000 of the people of Portugal are engaged in the fisheries, about 12,000 vessels being employed. Sardines and tunny are exported. The sardine industry is centred around Setubal. **Manufactures.**—*Azulejos* or porcelain tiles, an inheritance from the caliphate of Cordova, are still actively manufactured. Some chinaware, lace, and embroidery are also made.

Government, &c.—Till 1910 Portugal was a kingdom, the crown being hereditary both in the male and female line. The Constitution recognized four powers in the state—the legislative, executive, judicial, and moderating, the last vested in the sovereign. There were two Chambers, the Chamber of Peers and the Chamber of Deputies. On 20th Aug., 1911, a new Constitution was adopted, and provides for two Chambers. The first is called the National Council (164 members, elected by direct suffrage for three years), and the Upper or Second Chamber has 71 members, elected by all municipal councils, one-half retiring every three years. The President of the Republic is elected

by both Chambers for a period of four years, and he cannot seek re-election.

History.—The Phœnicians, Carthaginians, and Greeks early traded to this part of the peninsula, the original inhabitants of which are spoken of as Lusitanians, the country being called Lusitania. It was afterwards conquered by the Romans, who introduced into it their own civilization. The country was afterwards overrun by Alani, Suevi, Goths, and Vandals, and in the eighth century (712) was conquered by the Saracens. When the Spaniards finally wrested the country between the Minho and the Douro from Moorish hands, they placed counts or governors over this region. Henry the Younger of Burgundy, grandson of Hugh Capet, came into Spain about 1090, to seek his fortune in the wars against the Moors. Alphonso VI gave him the hand of his daughter, and appointed him (1095) count and governor of the provinces Entre Douro-e-Minho, Trazos-Montes, part of Beira, &c. The count, who owed feudal services to the Castilian kings, was permitted to hold in his own right whatever conquests he should make from the Moors beyond the Tagus (1112). Henry's son, Alphonso I, defeated Alphonso, King of Castile, in 1137, and made himself independent. In 1139 he gained the brilliant victory of Ourique over the Moors, and was saluted on the field King of Portugal. The Cortes convened by Alphonso in 1143 at Lamego confirmed him in the royal title, and in 1181 gave to the kingdom a code of laws and a Constitution. Alphonso extended his dominions to the borders of Algarve, and took Santarem in 1143. The capture of Lisbon (1147), which was effected by the aid of some English Crusaders and others, was one of the most brilliant events of his warlike life. The succeeding reigns from Alphonso I to Dionysius (1279) are noteworthy chiefly for the conquest of Algarve (1251) and a conflict with the Pope, who several times put the kingdom under interdict. Dionysius's wise encouragement of commerce, agriculture, manufactures, and navigation laid the foundation of the future greatness of Portugal. He liberally patronized learning, and founded a university at Lisbon, transferred in 1308 to Coimbra. By these and other acts of a wise and beneficent administration he earned the title of *father of his country*. He was succeeded by Alphonso IV, who, in conjunction with Alphonso II of Castile, defeated the Moors at Salado in 1340. Alphonso's son Pedro (1357-67) was succeeded by his son Ferdinand (1367-83), the last male of the legitimate line. John I, a natural son of Pedro, Grand Master of the Order of Avis, was recognized king by the Cortes, and reigned from 1385-1433. In 1415 he took Ceuta, on the

African coast, the first of a series of enterprises which resulted in those great expeditions of discovery on which the renown of Portugal rests. In this reign were founded the first Portuguese colonies, Porto Santo (1418), Madeira (1420), the Azores (1433), and those on the Gold Coast. The reigns of his son Edward (1433-8) and his grandson Alphonso V were less brilliant than that of John I; but the latter was surpassed by that of John II (1481-95), perhaps the ablest of Portuguese rulers. In his reign began a violent struggle with the nobility, whose power had become very great under his indulgent predecessors. The expeditions of discovery were continued with ardour and scientific method. Bartolommeo Diaz doubled the Cape of Good Hope in 1487, and Vasco da Gama reached India in 1498. In 1500 Cabral took possession of Brazil. While these great events were still in progress John II was succeeded by his cousin Emanuel (1495-1521). The conquests of Albuquerque and Almeida made him master of numerous possessions in the islands and mainland of India, and in 1518 Lope de Soares opened a commerce with China. Emanuel ruled from Bab-al-mandeb to the Straits of Malacca, and the power of Portugal had now reached its height. In the reign of John III, son of Emanuel (1521-57), Indian discoveries and commerce were still further extended; but the rapid accumulation of wealth through the importation of the precious metals, and the monopoly of the commerce between Europe and India, proved disadvantageous to home industry. The wisdom which had hitherto so largely guided the counsels of the Kings of Portugal now seemed to forsake them. The Inquisition was introduced (1536), and the Jesuits were admitted (1540). Sebastian, the grandson of John III, who had introduced the Jesuits, having had his mind inflamed by them against the Moors of Africa, lost his life in the battle against these infidels (1578). In 1580 the direct male line of the Kings of Portugal came to an end, and Philip II of Spain obtained possession of the throne and annexed the country. Although the Spanish yoke was grievous to the Portuguese, and many efforts were made to break it, the power of Philip was too great to be shaken. Portugal thus continued under the dominion of Spain till 1640, and her vast colonial possessions were united to the already splendid acquisitions of her rival. But these now began to fall into the hands of the Dutch, who, being provoked by hostile measures of Philip, attacked the Portuguese as well as the Spanish possessions both in India and America. They deprived the Portuguese of the Moluccas, of their settlements in Guinea, of Malacca, and of Ceylon. They also acquired about half of Brazil, which, after

the re-establishment of Portuguese independence, they restored for a pecuniary compensation. In 1640, by a successful revolt of the nobles, Portugal recovered her independence, and John IV, Duke of Braganza, reigned till 1656, when he was succeeded by Alphonso VI. In 1661 Charles II, King of England, married Catherine of Braganza, and a permanent alliance between Great Britain and Portugal was thus established. Pedro II, who deposed Alphonso VI, concluded a treaty with Spain (1668), by which the independence of the country was acknowledged. During the long reign of John V (1706-50) some vigour was exerted in regard to foreign relations, while under his son and successor Joseph I (1750-77), the Marquis of Pombal, a vigorous reformer such as Portugal required, administered the government. On the accession of Maria Francisca Isabella, eldest daughter of Joseph, in 1777, the power was in the hands of an ignorant nobility and a not less ignorant clergy. In 1792, on account of the sickness of the queen, Juan Maria José, Prince of Brazil (the title of the Prince-Royal until 1816), was declared regent. Portugal's connections with England then involved the country in war with Napoleon, and when the latter made an attempt to seize the kingdom, the royal family fled to Brazil. Queen Maria died in 1816, and John VI ascended the throne of Portugal and Brazil, but continued to reside in the latter country, leaving Portugal in the hands of the British. But absence of the court was viewed with dislike by the nation, and the general feeling required some fundamental changes in the government. A revolution in favour of constitutional government was effected without bloodshed in 1820, and the king invited to return home, which he now did. In 1822 Brazil threw off the yoke of Portugal, and proclaimed Dom Pedro, son of John VI, emperor. John VI died in 1826, having named the Infanta Isabella Maria regent. She governed in the name of the Emperor of Brazil, Dom Pedro IV of Portugal, who granted a new Constitution, modelled on the French, in 1826. In this year he abdicated the Portuguese throne in favour of his daughter Maria da Gloria. A long struggle between the reactionaries and the constitutionalists, and afterwards between the Chartists, or moderate constitutionalists, and the Septembrists, or advanced democrats, then followed, and democracy at last triumphed. King Carlos I, who ascended the throne in 1889, and his eldest son were assassinated at Lisbon on 1st Feb., 1908, and Manoel II, a younger son of the king, was raised to the throne. A brief revolution, however, drove him from the country, and Portugal was proclaimed a republic on 5th Oct., 1910. A Provisional Government under Theophilo

Braga was formed, and in Aug., 1911, Dr. Arriaga was elected President. Several Royalist risings, between 1911 and 1919, were defeated, and in Aug., 1919, Antonio Almeida was elected President. During the European War Portugal joined the Allies, declaring war against the Central Powers in March, 1916, and providing over 60,000 troops which eventually participated in the victorious entry into Lille.

Language.—Portuguese is one of the Romance, or Latin languages, as to-day spoken in Portugal, Brazil, and the Portuguese colonies. It resembles Spanish more than it does any of the other Romance tongues. It is the direct modern form of the popular Latin spoken by the Roman soldiers and colonists rather than of the classic speech of Rome. The dialect of Spanish spoken in Portugal at the beginning of the twelfth century was the Galician, which was also that of the court of Leon; but that court subsequently adopted the Castilian, which became the dominant language of Spain. The decline of the Galician dialect in Spain and the formation of the Portuguese language finally determined the separation of Spanish and Portuguese, and from cognate dialects made them distinct languages. Portuguese is considered to have less dignity than Spanish, but is superior to it in flexibility. In some points of pronunciation it more resembles French than Spanish.

Literature.—From the very first Portuguese literature was less original than the literature of France or Spain. The lyric spirit which in Portuguese literature preceded the epic was due to an impulse received from France. The oldest monuments of Portuguese literature do not go back further than the twelfth and thirteenth centuries, and the native literature could then boast of nothing more than popular songs. The first Portuguese collection of poetry (*cancioneiro*) was made by King Dionysius, and was published under the title of *Cancioneiro del Rey Dom Diniz*. Some poems on the death of his wife are attributed to Pedro I, husband of Inez de Castro. The sons and grandsons of John I were poets and patrons of the troubadours. Sá de Miranda marks the transition from the fifteenth to the sixteenth century and the separation of the Portuguese from the other Spanish dialects and from the language of the troubadours. The sixteenth century is the classic era of Portuguese literature. Pastoral poetry, the epic, and the chivalric romance flourished more than other branches of literature. The chief names are Sá de Miranda, Antonio Ferreira, Camoens, Diego Bernardes, Andrade Caminha, and Alvaras do Oriente. The principal epic and the greatest poem in the Portuguese literature, almost the only one

which has acquired a European reputation, is *Os Lusíadas* (The Portuguese) of Camoens (1524–80), which has placed its writer in the rank of the few great poets of the highest class whose genius is universally recognized. After Camoens as an epic writer comes Cortereal, who has celebrated the siege of Diù and the shipwreck of Sepulveda. Vasco de Lobeiro, Francisco Moraes, and Bernardim Ribeiro are among the leading romance writers. The drama also began to be cultivated in the sixteenth century. Sá de Miranda studied and imitated Plautus. Ferreira composed the first regular tragedy, *Inez de Castro*. Camoens wrote several theatrical pieces, among which are *Amphitryon* and *Seleucus*. Barros, also a romance writer, wrote a *History of the Conquest of India*. The *Commentaries* of Alphonso d'Albuquerque, by a nephew of the conqueror; the *Chronicle of King Manuel and of Prince John*, by Damian de Goes; the *History of the Discovery and Conquest of the Indies*, by Lopès de Castanheda; the *Chronicle of King Sebastian*, by Diego Bernardo Cruz, are all works of merit. By the opening of the seventeenth century Portugal's literary greatness had been succeeded by one of great activity, though of little real power. Innumerable epics were stimulated into being by the success of the *Lusiads*. During this period the native drama became almost extinct, being overshadowed by the Spanish. In the eighteenth century the influence of the French writers of the age of Louis XIV so completely dominated Portuguese literature that it became almost entirely imitative. The nation which had given birth to the *Lusiads* condescended to copy the *Henriade* and the *Lutrin*. Scholarship in this age made greater progress than literature. Towards the close of this century two writers appeared who have formed schools—Francisco Manoel do Nascimento (1734–1829), a polished lyrist, and Barbosa du Bocage. The latter introduced an affected and hyperbolic style of writing called *Elmanis*, from his adopted signature Elmano. In the nineteenth century patriotic feeling aroused by the Peninsular War and the struggle against Napoleon led to a greater activity, which was also witnessed in the domain of literature. Among the historians, novelists, and dramatists of this century may be mentioned: Almeida-Garrett (1799–1854), who tried to create a national drama; Herculano (1810–77), the author of a *History of Portugal*; the novelist Camillo Castello Branco (1825–90); and the poets Juão de Deus Ramos (1830–96) and Anthero de Quental (1842–92).

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Portuguesa, a west-central state of Venezuela, traversed by spurs of the Cordillera de Merida, and drained by the River Portuguesa, which rises in the Cordillera de Merida and unites with the Apure at San Fernando after a course of 200 miles. The state capital is Guanare. State pop. (1921), 52,429.

Portuguese East Africa, a Portuguese settlement, as the name implies, has an area of 428,132 sq. miles, and is divided into three distinct territories as under.

1. *Province of Mozambique*.—Area, 295,000 sq. miles. The territory is administered by a High Commissioner resident at Lourenço Marques, and is subdivided into the following districts, each under control of a Governor:

Lourenço Marques.	Quilimane.
Gaza.	Tete.
Inhambane.	Mozambique.

There are Government and Provincial Councils, and partial autonomy was granted in 1920. Lourenço Marques is the capital.

2. *Campanhia de Mozambique*.—The territories controlled by this Company, in which British capital is extensively interested, have an area of 59,840 sq. miles, and include most of the country between the Sabi River and the Zambezi, including Manica and Sofala. The Company has a charter granting sovereign rights for fifty years from 1891. There are fifteen divisions, as follows:

Division.	Population (1918).
Alto Save ¹	2,875
Beira	6,921
Buzi	17,019
Chemba	27,572
Cheringoma	11,166
Chiloane ¹	6,604
Chimoio	8,756
Chupanga	24,712
Gorongosa ¹	16,820
Manica	10,185
Moribane ¹	12,161
Mossurize	18,142
Neves Ferreira	2,859
Sena	32,399
Sofala ¹	22,481
Total	220,672

¹ In these districts there are less than 10 whites. About 2000 in all are of European origin or descent, and half of that number are located in or near Beira, the great majority being agriculturists. There is a small number of Indian Banyan traders and Arabs.

Topography, &c.—Half of the Mozambique Company's territories are lowlands, extending in the south on both sides of the Sabi River almost to the Rhodesian frontier. The climate

is arid. Where the Beira and Mashonaland Railway leaves the coast the coastal plain is much narrower, and it is in the uplands immediately west of the Rhodesian border that most of the whites are settled. Between the Zambezi and the railway the coastal plain is low and sandy, traversed by small streams that flow from the Cheringoma Plateau (1000 feet altitude). Part of this ridge is densely afforested and a favourite haunt of the elephant. The Urema depression lies just behind the Cheringoma Plateau. It is low and swampy, and from it tributaries flow north and south to the Zambezi and Pungue respectively. Along the Zambezi, the northern boundary of the Company's territories, the land is very flat. In the Rhodesian tableland, however, an altitude of 6500 feet is reached. The Gorongosa Mountains rise behind the Urema depression, and are much frequented by big game. The principal rivers traversing the southern part of the territory are the Sabi, Buzi (with its affluent the Revue), and Pungue. Beira stands on the low, sandy, northern shore of the estuary which receives the waters of the two latter rivers. See *Zambezi*.

3. *Nyasa Company*.—This chartered Company controls territories between Lake Nyasa and the Indian Ocean, and between the Rivers Rovuma (north) and Lurio (south). Area, 73,292 sq. miles.

The total population of Portuguese East Africa is given as about 3,000,000 natives, upwards of 10,500 whites, and 1200 Asiatics and mixed castes.

Ports.—The chief ports of the colony are: Beira, Mozambique, Ibo, Quilimane, Chinde¹, Inhambane, Porto Amelia, and Lourenço Marques.

Communications.—The Zambezi is navigated by stern-wheel steamers from Chinde as far up as Tete (about 300 miles), but owing to shifting channels and sand-banks any form of navigation is somewhat precarious. The Mozambique Company's territory is traversed by the Trans-Zambezia Railway (see *Zambezia*), and for 204 miles by the Beira-Mashonaland Railway, which joins the Rhodesian Trunk Line at Salisbury. The Delagoa Bay-Pretoria line has 57 miles of track within the colony. A new line from Lourenço Marques will tap the Swaziland borders, and railway construction generally will be further advanced. From Chindio to the Nyasaland frontier (44½ miles) is the Zambezi extension of the Shiré Highlands (Central Africa) line to Blantyre.

Production: Agriculture.—The products already established upon a good commercial basis include sisal hemp, sugar, maize, and

¹ Chinde was practically destroyed during a cyclone on 24th Feb., 1922 (see *Nyasaland* under *Towns*).

cotton; sugar being first in value and maize in actual tonnage. Portuguese East Africa is exceedingly rich agriculturally, and some lands are stated to yield 45 tons of sugar-cane to the acre. Sugar is grown mainly in the Zambezi Valley and along the Buzi River. (The Buzi Company produce sugar, brandy, alcohol (pure), maize, maize flour, bricks, and art tiles.) Maize is the chief crop of the white settlers, 200 of whom are settled in the uplands of the Maccuece and Chimoio districts, where ten bags are produced per acre, as against three in the Union and five in Rhodesia. Coffee is grown along the Beira line, ground nuts flourish everywhere, and wheat, beans, and fruit (including oranges, naartjes, and grape-fruit) are easily raised. The land is very suitable for tobacco, a yield of 750 lb. per acre having been reported. Among cattle a Shorthorn-Hereford cross is most favoured by European owners. Donkeys, oxen, some buffaloes, goats, horses, sheep, mules, and pigs are kept.

Forestry.—Lack of transport has prevented the exploitation of the forest wealth of Portuguese East Africa. Among trees of economic importance existing along the route of the Trans-Zambezia Railway between Dondo and the Zambezi River are furniture woods, such as the musakosa (*Azelia Cuanzensis*), katumbira or African walnut (*Pterocarpus Angolensis*), and ngunda, which resembles the *Khaya Senegalensis* or African mahogany. Many other rare woods exist, which are known only by their native names and are untapped excepting as sleepers for the railways. South of the Beira-Mashonaland Railway much of the country is densely afforested. It is remote from the railway, and development is unlikely for many years to come.

Minerals.—The only mines of any importance in active exploitation at the present time are the ancient gold- and copper-mines of the Campanhia de Mozambique, in Manicaland, which have produced about half a million sterling value of gold from the beginning of record-keeping to the present day. Modern mining was only begun in the 'nineties, and the following table gives some idea of the annual gold and copper output since that time.

Annual Output.	Gold.		Copper.	
	Ounces.	Value £.	Tons.	Value £.
To 1914	14,937	62,366	—	—
To 1915	15,614	52,284	—	—
To 1916	11,217	46,502	—	—
To 1917	9,276	37,858	307	30,700
To 1918	5,592	23,167	207	20,700
To 1913 from the beginning of modern mining	38,503	139,686	4,816	76,078

Tin, coal (near Tete),¹ and extensive deposits of cassiterite (79 per cent tin) have been found, and there are extensive mineral prospects in the Zambezi Valley.

¹A Belgian prospecting party recently spent two years in the Tete district, and discovered many valuable mineral deposits. The Société Minière et Géologique du Zambèze, a Belgian concern, financed the exploration work and has made arrangements for the exploitation of the Tete coal-fields. Coal will be sent by river steamer down the Zambezi to the railhead of the Trans-Zambezia Railway, thence by train to Beira, which, it is forecasted, will eventually become an important bunkering and coal-exporting centre.

Industries.—These are undeveloped but are progressive. They comprise mainly sugar manufactories, furniture-making (Lourenço Marques), cement and cold storage (at Port Matolla above Lourenço Marques), and a soap and oil factory.

See *Zambezi*; *Zambezia*; *Portugal*; *Tete*; and various other articles.

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Portuguese Man-of-war, the popular name of certain jelly-fishes included in the Hydrozoa. See *Physalia*; *Siphonophora*.

Portulacææ, **Portulacacææ**, or **Purslanes**, a small natural order of polypetalous dicotyledons, consisting of annual, perennial, herbaceous or shrubby plants, occurring in the hotter or milder parts of the world. *Portulaca oleracææ*, or common purslane, sometimes used in salads, is naturalized in many different countries. *P. grandiflora*, a South American species, is a fine garden annual with many ornamental varieties.

Poseidōn (po-si'dōn), the Greek god of the sea, identified by the Romans with the Italian deity Neptune. A son of Kronos and Rhea, and hence a brother of Zeus, Hēra, and Dēmētēr, he was regarded as inferior in power only to Zeus. The attributes ascribed and most of the myths regarding him have reference to the phenomena of the sea. The horse, and more particularly the war-horse, was sacred to Poseidōn, and one of the symbols of his power. During the Trojan War Poseidōn was the constant enemy of Troy, and after its close he is described as thwarting the return of Odysseus to his home for his having blinded Polyphēmus, a son of the god. Poseidōn was married to Amphitritē. His worship was common throughout Greece and the Greek colonies, but especially prevailed in the maritime towns. The Isthmian

games were held in his honour. In works of art Poseidōn is represented with features resembling those of Zeus, and often bears the trident in his right hand.

Posen, or **Poznan**, formerly a province of Prussia, now a county of Poland. The surface is flat, and greatly covered by lakes and marshes. A small portion on the north-east belongs to the basin of the Vistula; all the rest to the basin of the Oder. The soil is mostly of a light and sandy character, yielding grain, millet, flax, hemp, tobacco, and hops. Forests occupy 20 per cent of the surface. The inhabitants include many Germans, especially in the towns, but considerably more than half are Poles. The province was taken by Prussia after the partition of Poland (1772 and 1793). It was part of the Grand-Duchy of Warsaw from 1807 to 1815, when it was returned to Prussia. It was divided into the districts of Posen and Bromberg. By the Treaty of Versailles Posen was ceded to Poland. There are thirty-six districts in the county. Pop. (1921), 1,970,822.

Posen, or **Poznan**, a town of Poland, capital of the county of Posen, on the Warthe. It is a railway centre for lines from Berlin, Thorn, Breslau, Kreuzburg, and Kreuz (for Stettin). The principal buildings are the Dzialynski Palace, formerly a Prussian royal residence; the Rathaus (1550-5); and the Golden Chapel, erected by Count Raczinsky in 1842. Posen is a Polish archbishopric. The manufactures consist chiefly of agricultural machines, manures, woollen and linen tissues, carriages, leather, and lacquerware; there are breweries and distilleries. The town was taken by the Poles in Dec., 1918. Pop. (1921), 156,001.

Posidonia Australis (marine fibre), found in abundance in Spencer's Gulf and St. Vincent Gulf, South Australia, as well as in Tasmania: a perennial plant with underlying deposit of fibre. The fibre varies in length from 3 to 7 inches, is a little inferior in strength to jute, but is very brittle. This lack of elasticity is the chief objection to its employment as a textile fibre, although simple methods of treatment are said to render it softer and to add a little lustre to an otherwise almost lustreless material. On the other hand, it has a great affinity for colouring-matter, and is a good insulating agent against heat.

Posidonius, a Stoic philosopher, born in Syria about 135 B.C. He settled as a teacher at Rhodes, whence he is called the Rhodian. The most distinguished Romans were his scholars, and Cicero was initiated by him into the Stoic philosophy. Removing to Rome in 51 B.C., he died not long after. In his physical investigations he was more a follower of Aristotle than of the Stoic school.

Posill'po, an eminence which bounds the city of Naples on the west. It is traversed by a tunnel, called the Grotto of Posilipo, 2244 feet long, from 21 to 32 feet wide, with a height varying from 25 to 69 feet, through which runs the road to Pozzuoli. This tunnel is remarkable for its antiquity, having been made in the reign of Augustus. A second tunnel (the Grotto Nuova), constructed between 1882-5, gives passage to the tramway from Naples to Pozzuoli.

Positivism, or **Positive Philosophy**, a system of philosophy, of life and thought, dealing with realities and recognizing only the sure results reached by scientific methods. It excludes all supernatural and spiritual agencies and metaphysical speculations, and maintains that the only criterion of human knowledge is sense experience. Forerunners of positivism already existed among the Greek Sophists, but the founder of the system and the inventor of the term was Auguste Comte (q.v.). His system was both philosophical and religious. Philosophically he maintained that instead of investigating final causes of things, or the absolute, it is the business of the philosopher to take into consideration facts, and to inquire after the laws of things, i.e. the relations of facts to other facts. Theologically Comte's system excludes the existence of a personal, transcendent God, humanity becoming the object of veneration. The distinguishing idea which lies at the root of this twofold system is the conception that the anomalies of our social system cannot be reformed until the theories upon which it is shaped have been brought into complete harmony with science. The leading ideas of Comte's philosophy are: (1) the classification of the sciences in the order of their development, proceeding from the simpler to the more complex—mathematics, astronomy, physics, chemistry, biology, and sociology; and (2) the doctrine of the 'three stages', or the three aspects in which the human mind successively views the world of phenomena, namely, the theological, the metaphysical, and the scientific.

The religious side of positivism has somewhat the nature of an apology or afterthought. After doing away with theology and metaphysics, and founding his system on science or positive knowledge alone, Comte discovered that there was something positive in man's craving for a being to worship. He therefore had recourse to what he calls the cultus of humanity considered as a corporate being in the past, present, and future, which is spoken of as the *Grand Être*. This religion, like other forms of worship, requires for its full development an organized priesthood, temples, &c. Under the régime of positive religion Comte would include the political and social side of his system. Hence some of his

followers look forward to the establishment of an international republic, composed of the great western nations of Europe, destined ultimately to lead the whole world. Society in this great commonwealth will be reorganized on the basis of a double direction or control, that of the temporal or material authority, and that of the spiritual or educating body. Among the best-known admirers and adherents of Comte's theories were G. H. Lewes, J. S. Mill, Richard Congreve, H. Martineau, and particularly Frederic Harrison in England; and Pierre Laffitte, E. Littré, and H. Taine in France.—BIBLIOGRAPHY: Frederic Harrison, *The Creed of a Layman*; *Philosophy of Common Sense*; H. Ellis, *What Positivism Means*; A. J. Balfour, *The Religion of Humanity*; L. Lévy-Bruhl, *La Philosophie d'Auguste Comte*.

Possession, in English as in Roman law, is a thing quite distinct from ownership. Thus one man may have the physical possession of a thing, and another may have the right of possession, or property. Strictly speaking, possession denotes merely the state of having or holding. Possession may be either lawful, as in the case of a tenant, or unlawful, as in the case of a thief; ownership, on the other hand, presupposes legality. *Natural possession* exists when the proprietor himself is actually in possession. *Civil possession* is possession not by the owner, but by another in his name or for his behoof. *Actual possession* occurs when a person enters into lands or tenements descended or conveyed to him. *Possession in law* is said to exist when lands, &c., have descended to a man, and he has not actually entered into them.

Post-impressionism, a term used to describe a group of modern movements in art which together constitute a revolt against the ideals and methods of impressionism (q.v.), in that their aim is not the reproduction of the visual appearance of nature, but the combination of natural forms with a new and independent reality. In other respects the various forms of post-impressionism differ widely. The initiators of the movement fall into two main groups, those chiefly occupied with problems of form and design, and those who primarily use art to provide symbols for expressing emotion. In the first, the dominant figure is Paul Cézanne (1849–1906), whose aims were described by himself as those of “remaking Poussin in accordance with nature”, and of “making of Impressionism something solid and durable”. Nature for him was simply a starting-point. Contemplation of her, he held, led to perception of an underlying organic connection between visible forms, which it was the painter's work to realize on canvas, and so to attain coherent

design. An essential characteristic of nature being the third dimension, on the expression of this Cézanne laid great stress. He sought to record all the subtle colour variations in his subject, especially those due to objects being in different positions in space or in different relations to the source of light; and in this way not only defined individual forms, but fixed their position in space in relation to each other. The aims and methods of Cézanne have influenced, directly or indirectly, a large part of modern art. Among his most prominent modern followers are Marchand, Derain, and Segonzac. Another interesting figure, particularly admired by the Cubists, is Georges Seurat, whose success in uniting solid forms into monumental design was obscured by his practice of painting in round spots of pure colour, a method known as *divisionism* and based on impressionist ideas. The second group is typified by Paul Gauguin (1848–1903), whose restless and excitable temperament drove him to Tahiti and more remote islands, where he died. From an early impressionist phase he developed a boldly decorative art of rich colour, which aims at expressing the feelings inspired in the painter by his surroundings. Similar in outlook was Vincent van Gogh, a Dutchman settled in France, who united with a design which owes much to Japanese influence, vivid colour, which seeks not to mimic nature but to express his emotions. The first well-marked group to develop from these beginnings was that of the *symbolistes*, who hold that the aim of painting is the expression of an idea. Their most distinguished living representatives are Paul Sérusier and Maurice Denis. Another group, influenced in part by the decorative and symbolic art of Gustave Moreau, includes Henri Matisse, whose arbitrary use of colour and bold distortion of forms won for the group the nickname of *les fauves* (the wild men). In reaction against these extravagances, as much as against impressionism, is the concern with solid form and with its arrangement into abstract designs of Cubism (q.v.), in which movement Pablo Picasso is the chief figure. Contemporary, but quite different in character, is Futurism (q.v.), an attempt to express pictorially sensations of movement and growth. Similar to cubism in its use of geometric forms, and to futurism in its insistence that art should be a reflection of contemporary life, is the English Vorticist movement. This is based on the idea that the artist has a general conception of relations in the universe, which is his *vortex*, through which ideas pass and take concrete shape therefrom; just as by substituting definite quantities for algebraic symbols in the general equation of a circle, a particular circle is obtained. In practice the Vorticists have been

mainly concerned with a rather mechanical presentment of underlying structure.—BIBLIOGRAPHY: W. H. Wright, *Modern Painting*; R. Fry, *Vision and Design*; C. Bell, *Since Cézanne*.

Postmaster-General, the chief executive head of the postal and telegraphic systems of Britain. He is usually a member of the Cabinet, and exercises authority over all the departments of the postal and telegraphic systems, including money orders, savings bank, insurances, and annuities.

Post-obit Bond, a bond given for the purpose of securing to a lender a sum of money on the death of some specified individual from whom the borrower has expectations. Such loans are not only generally made at usurious rates of interest, but usually the borrower has to pay a much larger sum than he has received, in consideration of the risks the lender runs in the case of the obliger predeceasing the person from whom he has expectations. If, however, there is a gross inadequacy in the proportions amounting to fraud, a court of equity will interfere.

Post Office. The earliest reference to a regular postal system in England is found in the statutes of Edward III. Royal messengers were then employed as letter-carriers, and this developed until the post office became an established department of Government activity. Sir Brian Tuke (1533) was the first Postmaster of whom we have any record. In 1543 a post was established by which letters were carried from London to Edinburgh, taking four days for the journey. Postal services between Scotland and England were greatly improved during the reign of James I, and a Continental service was instituted. Lord Stanhope was appointed Postmaster for Britain in 1607, and in 1619, while he held office, the new post of Postmaster for foreign parts was created, to which Matthew de Quester was appointed. Merchants continued to use their private and local posts and carriers until the beginning of the reign of Charles I, and the universities and large towns organized systems of their own. The king forbade the use of these private ventures, reformed the national system, and claimed the revenue. A penny post within the London area was instituted in 1683. During the reigns of William III and Anne many improvements were introduced into the postal system, but from that time until the middle of the nineteenth century there was little change.

Sir Rowland Hill, the author of the post-office system as we know it to-day, outlined his schemes in a pamphlet (*Post Office Reform*) which he published in 1837. In those days postal charges were so high that Daniel O'Connell

complained that Irish labourers in England had to spend one-fifth of their week's wages every time they wrote to their people at home and got an answer back. There were large districts in England where the postman was never seen, and the major part of the correspondence of the country did not pass through the post office. Sir Rowland Hill noticed that the revenue of the post office continued to diminish instead of increasing with the population and wealth of the country, and suggested the introduction of the penny post throughout the country as a means of increasing the revenue. His analysis of the figures available from the London district post and the money collected throughout the country showed the probable average cost of receipt, transmission, and delivery of a letter as 0·84 of a penny, of which one-third went to meet transmission charges and two-thirds collection and delivery. He developed his proposals in later pamphlets, and tried repeatedly to get facilities to study postal affairs from inside, but every endeavour to obtain an entry to the post office for this purpose was prevented, and his study of the system had to be confined to the perusal of the figures in Government Blue books.

The scheme outlined by Sir Rowland Hill was adopted, and on 10th Jan., 1840, the uniform rate of one penny for a half-ounce for prepaid letters came into operation. The success of this scheme was largely contributed to by the introduction of adhesive postage-stamps, referred to in 1837 by Hill, before the Commission appointed to inquire into the working of the post office, as "bits of paper just large enough to bear the stamp and covered at the back with a glutinous wash", but believed to be the idea of James Chalmers, of Dundee.

The opposition of the Government and civil servants to reform of the postal system was of such a character that *The Times* of 16th March, 1839, said, "it was the cause of the whole people of the United Kingdom against the small coterie of place-holders in St. Martin's-le-Grand and its dependencies". Despite the earnest endeavours of the postal staff, who had the deep-rooted opposition to all reform which is apt to be characteristic of civil servants, the scheme could not be made a failure, and even the dismissal of Hill by Sir Robert Peel in 1841, leaving the opponents of the measure in full possession of the machine and with every facility to increase the cost of its working, which they delighted in doing, did little to reduce the enthusiasm of the British public for postal reform, their faith in Sir Rowland Hill, or the success of his scheme.

The adoption of postal carriages on the railways greatly facilitated the handling of correspondence. These carriages are fitted with an apparatus in which letter-bags are collected

while the train continues on its journey, and the letters are sorted in the van by the travelling staff. The reduction of the cost of carriage, the great increase in the rapidity of transmission, the immense development of commerce, together with the increase of population, have had the effect of enormously multiplying the work done by the post office. In 1839 the total number of British letters conveyed through the post office was estimated at about 76 millions; in 1921-2 it had reached 3350 millions, in addition to which 500 million post cards, 1150 million 'printed papers', and 190 million newspapers were transmitted.

The power possessed by the Secretaries for State to issue warrants to open or to detain correspondence passing through the post office has been the cause at different times of popular agitations, notably in the case of Mazzini's letters in the summer of 1844. Such warrants are only issued for two purposes: "the furtherance of criminal justice", and "the determination of the designs of persons known or suspected to be engaged in proceedings dangerous to the State or deeply involving British interests".

The development of the whole postal service we know to-day was a very gradual process. One after another of the departments of activity was added after, frequently long after, there was a manifest public demand. Letter cards were introduced in 1892, after they had been in use for many years on the Continent, where they were very popular. In 1870 post cards were provided by the post office, but only one kind of card was permitted until the stationers' complaints were met by allowing private persons to have their own cards stamped at Somerset House. The use of reply post cards dates from 1893. The popularity of picture post cards has contributed considerably to the great increase in post-card traffic. The inland parcels post was inaugurated in Aug., 1883. The registered-letter system provides all the measure of safety in transit required for ordinary correspondence, but its use by financial houses to dispatch large quantities of bank notes from branch offices to their head-quarters has led to some cases of theft. An Imperial Penny Post was instituted on Christmas Day, 1898, between most of the countries within the Empire and the Motherland. South Africa and Australia adopted the scheme later, and by 1911 the idea had become a reality.

The money-order scheme was instituted in 1792 to give safe conveyance of money to soldiers and sailors. At that time it was thought that it was not legal for the post office to undertake money-order business, and the system was run as a private venture by six officers of the post office known as 'Clerks of the Roads'.

This scheme was terminated six years later, but the money-order department continued as a private business in the hands of three post-office clerks as 'Stow and Company'. In 1838 the sole remaining partner of this concern was bought out by the Government with a pension of £400 a year, and since then the money-order scheme has been run actually as a post-office department.

The post-office savings bank owes its origin to a suggestion made in 1860 by Charles William Sykes, of Huddersfield, which was immediately taken up by W. E. Gladstone, who was then Chancellor of the Exchequer. An Act of Parliament established it in 1861. The scheme has been very successful, and the very sensible action of starting the school penny-savings-bank system in 1892, when the Free Education Act was introduced, did much to popularize thrift and extend the field of the bank's activities. The total amount credited to depositors at the end of the year 1920 was over £266,000,000.

The telegraph service was started in 1870, when telegrams were dispatched at the rate of one shilling for twenty words and threepence for each additional group of five words; the addresses of both sender and receiver were transmitted free. In the year 1885 the six-penny telegram was introduced, with a half-penny overcharge for each additional word over twelve, with the names and addresses included as words. A registered-address system, whereby a firm can register a word as equivalent to its name and address at a cost of one guinea (now £2) a year, was started at the same time. Press matter is telegraphed at very cheap rates. The telegraph system is a department of the post office which does not pay its way. The balancing of costs of working with probable business does not seem to an outsider to be a problem of such outstanding difficulty as to admit of no solution in the fifty years during which the department has been in existence. On the introduction of telephony in 1878 there was considerable litigation between the post office and the early telephone companies regarding the powers conferred on this Government department under the Telegraph Act. The post office won in these cases, but appeals were intimated which never came to trial, because amicable working arrangements were made with the telephone companies, under which they obtained licences to work in particular districts. The telephones in the cities of the country were worked by a private company and some few municipalities—Glasgow, Tunbridge Wells, Portsmouth, Brighton, Swansea, and Hull—until 1st Jan., 1912, when the whole system was nationalized. In spite of the fact that there was considerable uncertainty as to how

long the Government were going to tolerate private enterprise in the telephone business, which must have hampered and in many ways completely arrested the development of the telephone service, the National Telephone Company showed that it was possible to run the system well and profitably with reasonable rates. When the system was taken over by the Government, troubled and dissatisfied subscribers became more and more numerous as time went on. It has been said that much of the criticism of the department was due to the prejudice of British business men against nationalization in any form or Government interference in business. Whether this be so or not, there is undoubted evidence that a new and very undesirable spirit of irresponsibility, which is to a certain extent characteristic of municipal and national enterprise, has entered what was previously a business-like and efficient machine.

In 1921 the letter rate was raised to twopence for three ounces, and the post-card rate to three-halfpence. The immediate effect was a great reduction in traffic, which was handled at very high cost because the old staff had been retained. The pictorial post-card business experienced a considerable set-back. The irritation of the business public was expressed in many petitions and much 'lobbying' at the House of Commons. At last, in 1922, when Sir Robert Horne was Chancellor of the Exchequer, the postal rate was reduced to three-halfpence for an ounce and the post-card rate to one penny.

The present rates for the various postal services and other interesting information will be found in *The Post Office Guide*.

Post-office Insurance, a department of the British post office, the duties of which include the issuing of Government annuities as well as of life-assurance policies, first fully organized in 1865. Annuities, either immediate or deferred, payable half-yearly, from £1 up to £100, may be purchased for any person of five years of age and upwards, and the persons so insured have a Government guarantee for the payment of the money. Deferred annuities may be purchased either by a single payment or by instalments. By paying higher premiums the person on whose life the annuity depends may secure the repayment to his representatives of all the premiums paid up to his death, if that event should take place before the annuity becomes due. Policies of insurance for sums not less than £5, nor more than £100, may be issued to any person between the ages of fourteen and sixty-five, and the premiums may be paid by yearly, half-yearly, quarterly, monthly, or fortnightly instalments, provided no payment be less than 1s. Complete tables of the premiums

payable in this department may be seen at any local post office. Consult also *The Post Office Guide*.

Post-pliocene, in geology, the periods following the Pliocene, and including the Pleistocene (q.v.) and the Recent periods, the latter being the first period of the Quaternary era. See *Post-tertiary*.

Post-tertiary, in geology, the Lyellian term for all deposits and phenomena of more recent date than the Norwich or mammaliferous crag. It is thus equivalent, in ordinary usage, to Post-pliocene. Beneath the accumulations of the *historic* epoch, comprising alluvia, peat, &c., in process of formation, come *prehistoric* deposits, the remains in which are older, comprising stone implements, pile-dwellings, and extinct animals, as the Irish deer, mammoth, &c. These deposits include in the British area raised beaches and submerged peat, showing considerable changes in the coast-line, and they graduate downwards into the accumulations of the Glacial epoch.

Potamogeton (-mo-gē'ton), a genus of aquatic plants belonging to the nat. ord. Naiadaceae. It has a perfect flower, a four-pointed perianth, four sessile anthers, four ovaries, and four drupes or nuts. Several species are indigenous to Britain, where they are known by the name of *pond-weed*.

Potash, the name originally given to the product obtained when a solution of vegetable ashes is evaporated to dryness in iron pots, and the residue calcined. It derives its name from the *ashes*, and the *pots* (called potash kettles) in which the solution was evaporated. In the crude state it is impure potassium carbonate, and when purified is known as pearl-ash. It is used in the making of glass and soap, and large quantities of it are now produced from certain 'potash minerals' (especially carnallite), instead of from wood ashes. The name potash is often given to potassium hydroxide, KOH, which is also termed *caustic potash*. This is either prepared by boiling a solution of potassium carbonate and then adding quicklime or baryta, or by the electrolysis of a solution of potassium chloride. It is a white solid, usually sold in lumps or in the form of sticks, dissolves readily in water, and has a strongly alkaline reaction. It changes the colour of many natural colouring-matters, and corrodes most animal and vegetable tissues. It rapidly absorbs moisture and carbon dioxide from the atmosphere. It neutralizes all acids, yielding the corresponding potassium salts, and is largely made use of in the manufacture of soft soap. It is fusible at a temperature of 360° C. It is used in surgery, under the name of *lapis causticus*, to destroy warts and other growths, and to clean the

wounds produced by the bites of animals. See *Potassium*.

Potash Salts, a popular name for a number of minerals soluble in water and containing potassium chloride, which are in demand as agricultural fertilizers. Those commercially available are kainite, carnallite, and sylvine; the last named is usually much mixed with rock-salt, and is sold thus as 'sylvinite'. The potassium-content, for trade purposes, is calculated as potash. The chief sources are the mines of Stassfurt, near Magdeburg, and the Rhine-vale, near Mulhouse, Alsace. The yearly output of Stassfurt alone amounts to about 550,000 to 600,000 tons of potassium salts, mostly chloride. As the two largest sources of this mineral were in German hands during the European War, there was a famine in potash for the world outside Central Europe. The dust from the flues of blast-furnaces was found to contain a large proportion of potassium salts, and many thousands of tons were used in Britain. Nebraska, by extracting supplies from her alkali lakes, enjoyed a momentary activity as a potash producer, and in 1918 was able to ship 150,000 tons.

Potas'sium (a Latinized term from *potash*), a name given to the metallic element obtained from potash; discovered by Davy in 1807, and one of the first fruits of his electro-chemical researches; symbol, K; atomic weight, 39.10. Next to lithium it is the lightest metallic substance known, its specific gravity being 0.862 at the temperature of 60° F. At ordinary temperatures it may be cut with a knife and worked with the fingers. At 32° F. it is hard and brittle, with a crystalline texture; at 50° F. it becomes malleable, and in lustre resembles polished silver; at 150° F. it is perfectly liquid. It is usually manufactured by the electrolysis of the hydroxide or chloride, and is an important constituent of saltpetre, common alum, and most manures. Potassium combines very readily with oxygen, and is capable of abstracting it from various oxygen compounds. A freshly exposed surface of potassium instantly becomes covered with a film of oxide. The metal must therefore be preserved under a liquid free from oxygen, petroleum being generally employed. It decomposes cold water with great readiness; hydrogen gas is evolved and burns with a violet-coloured flame, due to potassium vapour which is present; the other product is caustic potash, which dissolves in the water. *Potassium chloride* (KCl) is known in commerce as 'muriate of potash', and closely resembles common salt (sodium chloride). *Potassium bromide* and *iodide* are useful drugs. (For the *carbonate* and *hydrate*, see *Potash*.) *Potassium bicarbonate* is obtained by exposing a solution of the carbonate to the

air, carbon dioxide being absorbed from the atmosphere, and crystals being deposited; or it is formed more directly by passing a current of carbon dioxide through a solution of the carbonate of such a strength that crystals form spontaneously. It is much used in medicine for making effervescing drinks. *Potassium nitrate* is *nitre*, or *saltpetre*. (See *Nitre*.) *Potassium sulphate* (K_2SO_4) is used medicinally as a mild laxative, in making some kinds of glass and alum, and in manures. The *bisulphate* ($KHSO_4$) is used in calico-printing and dyeing. *Potassium chlorate* ($KClO_3$) is employed in the manufacture of lucifer matches, and is very valuable in medicine, especially in ulceration of the mouth, for which it is the specific. It is a well-known source of oxygen. The *bichromate* ($K_2Cr_2O_7$) is used in calico-printing and dyeing. *Potassium cyanide* (KCN) is much used in extraction of gold from its ores and in photography.

Potato (*Solanum tuberosum*), a plant belonging to the nat. ord. Solanaceæ, which also includes such poisonous plants as nightshade, henbane, thorn-apple, and tobacco. We owe this plant to western South America, where it still grows wild chiefly in the region of the Andes, producing small, tasteless, watery tubers. The potato was first introduced into Europe, after the conquest of Peru, by the Spaniards, by whom it was spread over the Netherlands, Burgundy, and Italy before the middle of the sixteenth century. In Germany it is first heard of as a rarity in the time of Charles V. Sir John Hawkins, Sir Francis Drake, and Sir Walter Raleigh are all credited with the first introduction of the tuber into England (1565). Although the potato was tolerably widely distributed on the continent of Europe before its appearance in Britain, it seems to have been cultivated more as a curiosity than as an article of food, and Ireland is said to have been the country in which it was first cultivated on a large scale for food. In the course of the eighteenth century it became a favourite article of food with the poorer classes in Germany; but in France there existed so violent a prejudice against it that it did not come into general use until towards the end of the century. The potato is a perennial plant, with angular herbaceous stems, growing to the height of 2 or 3 feet; leaves pinnate; flowers pretty large, numerous, disposed in corymbs, and coloured violet, bluish, reddish, or whitish. The fruit is globular, about the size of a gooseberry, reddish-brown or purplish when ripe, and contains numerous small seeds. The tubers, which furnish so large an amount of the food of mankind, are really underground shoots abnormally dilated, their increase in size having been greatly

fostered by cultivation. Their true nature is proved by the existence of the 'eyes' upon them. These are leaf-buds, from which, if a tuber or a portion of it containing an eye is put into earth, a young plant will sprout, the starchy matter of the tuber itself supplying nutriment until it throws out roots and leaves, and so attains an independent existence. The potato succeeds best in a light sandy loam containing a certain proportion of vegetable matter. The varieties are very numerous, differing in the time of ripening, in their form, size, colour, and quality. New ones are readily procured by sowing the seeds, which will produce tubers the third year, and a full crop the fourth. But the plant is usually propagated by sowing or planting the tubers, and it is only in this way that any one variety can be kept in cultivation. Like all plants that are extensively

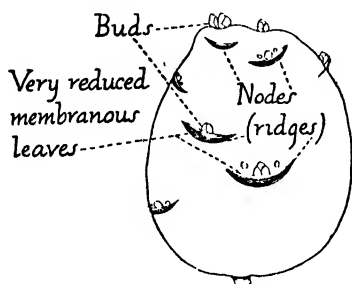


Diagram of Tuber of Potato

cultivated, and under very different circumstances of soil, climate, and artificial treatment, the potato is extremely subject to diseases, among the more important of which are blight (*Phytophthora infestans*) and wart-disease (*Chrysophyctis endobiotica*). (See articles *Phytophthora* and *Chytridinae*.) The potato is also attacked by various insects, the most destructive being the Colorado beetle. The tubers consist almost entirely of starch, and being thus deficient in nitrogen, should not be too much relied on as a staple article of diet. Potatoes are extensively used as a cattle-food, and starch is also manufactured from them. A coarse spirit (Berlin spirit, British brandy) is also obtained from them by distillation, the starch being converted into sugar by means of malt or sulphuric acid, and fermentation set up.

Potato Frog-fly (*Chlorita solani*), an insect which injures the potato plant by sucking its juice, allied to the cuckoo-spit fly, and belonging to the ord. Hemiptera.

Potchefstroom (pot'shef-ström), the oldest town in the Transvaal, on the Mooi River. It was founded by Hendrik Potgieter in 1838, and was at one time capital of the Boer Re-

public. In 1880 Cronje besieged the British garrison of 250 men, who capitulated just after an armistice had been arranged by the Boer leaders. During the Boer War (1899-1902) Colonel B. T. Mahon took the town without opposition (June, 1900). Pop. 10,000 (white).

Potemkin (pot-yom'kin), Gregory Alexandrovitch, Russian general and statesman, a favourite of the Empress Catherine II, born in 1739, died in 1791. One of the conspirators who brought about the dethronement of Peter III in favour of his wife Catherine II, he attracted the attention of the empress and became her favourite. For a period of more than fifteen years he exercised a boundless sway over the destinies of the empire. The partition of Poland was due to his influence. In 1783 he suppressed the khanate of the Crimea, and annexed it to Russia. In 1787, being desirous of expelling the Turks from Europe, he stirred up a new war, in the course of which he took Otshakov by storm (1788).

Potential, in physics and electrical engineering, a quantity the rate of variation of which from point to point determines the tendency towards motion of some physical entity, such as a material body, a charge of electricity, or a magnetic pole. Potential is thus analogous to temperature in heat conduction, and to pressure in the motion of fluids.

Electric Potential.—A general account of the properties and methods of measurement of potential in electrical science is given in the articles *Electricity*; *Electromotive Force*; *Voltmeter*. We give here a somewhat fuller account of the theory of the *electrostatic* potential. The simplest case is that in which the electric field is due to a single charge concentrated at a point A. By Coulomb's Law, the force on a unit positive charge at P, due to a charge of q units at A, is q/r^2 , where $r = AP$, the medium being air, and the units electrostatic. If the charge at A is kept fixed, and the unit charge moves from P to Q, the work done by the electric force between the charges is independent of the path taken between P and Q. If it were not so, and if more work were done on the unit charge in a path PEQ than in another path PFQ, then we could let the unit move along PEQ and carry it back along PFQ, so securing a certain surplus amount of work, contrary to the Principle of the Conservation of Energy. The *potential* at P is defined to be the work done in moving the unit from P out of the field altogether, i.e. to infinity. Taking the path along the prolongation of AP, we find for this work the integral of $(q/r^2)dr$, from r to infinity, which is q/r . The potential at P due to q units at A is therefore q/r . When there is any number of charges producing the field, q_1 at A, q_2 at B,

&c., the potential at P is proved in a similar way to be $q_1/AP + q_2/BP + \dots$

If the unit charge moves from P to a point Q very near P, the work done is $F \times PQ$, where F is the *component*, along PQ, of the force at P. By definition, this work is the fall of potential from P to Q, say $V_P - V_Q$. Hence $F = (V_P - V_Q)/PQ$; or, in words, the component force at P along PQ is the rate of fall of the potential per unit length in the direction PQ at P. If X, Y, Z are the components, in the directions of the rectangular co-ordinate axes, of the *electric intensity*, or force on a positive unit, at P, we have therefore $X = -dV/dx$, $Y = -dV/dy$, $Z = -dV/dz$. The *intensity* at P is a *vector* having, in general, a definite direction and magnitude. An *equipotential surface* is a surface at every point of which the potential has the same value. At any point on such a surface the component force in any direction tangential to the surface is zero, and the intensity is therefore normal to the equipotential surface, i.e. *the lines of force are perpendicular to the equipotential surfaces*.

There are some important differential equations connecting the potential with the distribution of electricity in a static field. One of the simplest methods of obtaining these equations depends on a theorem due to Gauss, which states that the surface integral of the outward normal component of the electric intensity, taken over any surface, is equal to the algebraic sum of the charges within the surface, multiplied by 4π . The meaning of the theorem may be seen by taking the very simple case of a single charge q at the centre of a spherical surface of radius r . In this case the normal component of the intensity is the whole intensity q/r^2 , and the surface integral is the integral of $(q/r^2)dS$, or q/r^2 into the integral of dS , i.e. $(q/r^2)(4\pi r^2)$ or $4\pi q$. The general case admits of an interesting physical proof. Suppose the space within any surface to be occupied by liquid. Suppose also that at the point A of the space there is a *source* (such as the mouth of a pipe of negligible volume, led in from outside) from which $4\pi q$ units of volume of liquid issue per unit time. The liquid being incompressible, the volume $4\pi q$ per unit time must cross any surface surrounding the source. The liquid moves radially from the source; if v is its velocity at distance r , the volume crossing per unit time the surface of the sphere of radius r with its centre at the source is $4\pi r^2 v$. But this is $4\pi q$, so that $v = q/r^2$. The velocity in the hydrokinematical problem is therefore the same in magnitude and direction as the force in the electrostatic problem. Consider now the surface with which we started. The volume of liquid crossing the element dS of this surface per unit time is the volume of a thin cylinder

of base dS , and height $v \cos\theta$, where θ is the angle between the directions of r and the outward normal. Hence the integral of $v \cos\theta dS$, i.e. of $(q/r^2)\cos\theta dS$, is $4\pi q$; which is the theorem of Gauss for this case; the general case follows by addition. We can apply the theorem to a small rectangular solid with one corner at $P(x, y, z)$ and with dx, dy, dz for its edges. The contributions to the surface integral can be taken separately for the six faces of the solid. The normal component of the intensity (in the direction outwards from the surface) is, at the x -face through P, $+dV/dx$. The value of this function (dV/dx) , when x is changed to $x + dx$, is $dV/dx + (d^2V/dx^2)dx$, by the theorem $f(x + h) = f(x) + hf'(x)$, which is approximately true when h is small (see *Taylor's Theorem*). For the faces x and $x + dx$, the outward normals are in opposite directions, so that the contribution to the surface integral from the x -face is $(dV/dx)dydz$, and that from the $x + dx$ face is $(-dV/dx)dydz - (d^2V/dx^2)dx dydz$; and the net contribution from the two faces is $-(d^2V/dx^2) dx dydz$. The whole surface integral is therefore $-(d^2V/dx^2 + d^2V/dy^2 + d^2V/dz^2) dx dy dz$. This is equal to the charge within the volume element, multiplied by 4π ; or it is equal to $4\pi \rho dx dy dz$, where ρ is the volume density of charge at (x, y, z) . We thus obtain *Poisson's equation* $d^2V/dx^2 + d^2V/dy^2 + d^2V/dz^2 + 4\pi\rho = 0$. In a region where there is no charge $\rho = 0$, and the equation becomes $d^2V/dx^2 + d^2V/dy^2 + d^2V/dz^2 = 0$, which is *Laplace's equation* (q.v.).

In the very important case of a distribution of charge in a thin layer over a surface, with surface density (charge per unit area) σ , we can apply the theorem of Gauss to the small cheese-shaped volume bounded by two elements of area parallel to the element dS of the charged surface (one element outside the surface, the other within it), and by lines perpendicular to dS joining the edges of the two elements. These joining lines may be taken so short that, in the limit, only the elements parallel to dS contribute to the surface integral. We thus find the *surface equation* $dV/dn_1 + dV/dn_2 + 4\pi\sigma = 0$; where dn_1 and dn_2 are elements of length along the normal, one drawn inwards and the other outwards, and both in the direction away from the surface. In a field containing volume and surface distributions, the potential itself is continuous everywhere; its first derivatives with respect to x, y , and z are also continuous at points of finite volume density; but, at a surface on which there is a surface distribution, a first derivative, such as dV/dx , has not the same value at a point just within the surface as it has at an infinitely near point just outside the surface. The derivative in any direction lying in the surface is continuous across the

surface, but the normal derivative changes in value abruptly by the amount $4\pi\sigma$, this conclusion being the immediate interpretation of the surface equation.

In a conductor, electricity is free to move; hence, if there is equilibrium, the distribution must be such that, at every point in the substance of the conductor, the intensity is zero and the potential therefore constant. Poisson's equation then shows that the volume density is everywhere zero; also, since the first derivatives of the potential are continuous (being zero), there is no surface density at any point actually *within* the substance of the conductor. If the conductor is hollow, the potential in the internal space can be shown to be constant, and equal to the potential of the conductor. One method of proving this depends on the very important property of Laplace's equation that, within a given region, it has only one solution taking a given value at the boundary of the region. If $V = C$ at every point of the boundary, then $V = C$ is one solution for the internal space satisfying Laplace's equation and the boundary condition; $V = C$ is therefore the solution. It follows that the charge on a conductor, whether solid or hollow, resides entirely on the outer surface. The density of the surface charge is given by the surface equation, which in this case takes the simplified form $dV/dn = -4\pi\sigma$, since, along the *inward* normal, the rate of variation of V per unit length is zero.

As a simple but important example of the application of Laplace's equation and the surface equation, take the ideal case of a conductor bounded on one side by an infinite plane surface, the equation of which we may take to be $z = 0$. Let z be negative in the conductor itself. The potential V in the field (where z is positive) does not depend on x or y , so that V is a function of z only, and $d^2V/dz^2 = 0$; the solution of this equation is $V = Az + B$. The value of B is immaterial; the value of A can be expressed in terms of the surface density σ . For we have here $dV/dn = dV/dz = A$, so that $A = -4\pi\sigma$, and $V = -4\pi\sigma z + B$. The intensity at any point is in the z -direction, and its value $-dV/dz$ is $4\pi\sigma$. The intensity is therefore the same at all distances from the charged surface. If there are *two* plane conducting surfaces, parallel to each other, say $z = 0$ at potential V_0 and $z = d$ at potential V_1 , then $V = V_0 + (V_1 - V_0)z/d$, for this satisfies Laplace's equation and the surface conditions. At $z = 0$, $4\pi\sigma = -(V_1 - V_0)/d$; and at $z = d$, $4\pi\sigma = +(V_1 - V_0)/d$, since, in the latter case, $dV/dn = -dV/dz$. The intensity at any point in the field, i.e. between the surfaces, is $-dV/dz$, or $(V_1 - V_0)/d$. Half of this force on the exploring unit is obviously due to the repulsion of one plane, half to the attraction

of the other. We can therefore calculate the force with which an area A on $z = d$ is attracted to the other plane. For the charge on the area A is σA , or $A(V_1 - V_0)/4\pi d$, and the intensity due to the distribution on $z = 0$ is $(V_1 - V_0)/2d$. The force on A is therefore $A(V_1 - V_0)^2/(8\pi d^2)$. The action of one of Lord Kelvin's electrometers, the guard-ring or attracted disc instrument, is based on this formula.

It will be observed that the density σ , for a given difference of potential between the opposing conductors, is inversely proportional to the distance d between them. This is the principle of *condensers*. The *capacity* per unit area of the arrangement is defined to be the ratio of the charge per unit area on either surface to the difference of potential; it is therefore $\sigma/(V_1 - V_0)$ or $1/(4\pi d)$.

For the investigation of potential problems when the bounding surfaces of the field are curved, it is convenient to transform Laplace's equation to an equivalent equation in terms of appropriate co-ordinates. The transformation is easily made with the help of the theorem of Gauss. In a few important cases, conditions of symmetry enable us to reduce the equation to a particularly simple form. For example, let the bounding surfaces be two of a family of concentric circular cylinders, and let V have the constant values V_0 at the inner surface $r = a$, and V_1 at the outer surface $r = b$. The potential in the field will be a function of r only, if we assume the cylinders to be infinitely long. Applying the theorem of Gauss to the volume bounded by any two cylinders of the family, and by two planes at unit distance apart and perpendicular to the common axis, we find that $2\pi r dV/dr$ has the same value at the two cylindrical surfaces, so that $r dV/dr$ is constant, equal to C , say. Thus $dV/dr = C/r$, and $V = C \log_e r + D$. The constants are found from the surface conditions $V_0 = C \log_e a + D$, and $V_1 = C \log_e b + D$. The value of C is therefore $(V_1 - V_0)/\log_e(b/a)$. If σ is the surface density at $r = b$, then $4\pi\sigma = -dV/dn = dV/dr$, for $r = b$; or $4\pi\sigma = C/b$. The capacity per unit length = charge \div potential difference = $\sigma \cdot 2\pi b/(V_1 - V_0) = \frac{1}{2} C/(V_1 - V_0) =$ the reciprocal of $2 \log_e(b/a)$.

Gravitational Potential.—The law of gravitation being of the same form as the law of force between electrified particles, calculations of attractions between material bodies can be made to depend on a gravitational potential. The potential due to a mass m may be taken to be m/r as in the electrical case, and Poisson's equation still holds good. The gravitational potential is therefore the potential energy of unit mass, *with sign changed*. Matter is found in distributions of finite density per unit volume;

surface density does not occur, so that the first derivatives of the potential are everywhere continuous. As an illustration, consider the potential of a sphere of radius a , and uniform density ρ . Apply the theorem of Gauss to the region within a concentric sphere of radius r , where r is less than a . From symmetry, the potential is a function of r only, and we have $-4\pi r^2 dV/dr = 4\pi \rho \cdot 4\pi r^3/3$, or $dV/dr = -4\pi \rho r/3$, and $V = -2\pi \rho r^2/3 + C$. The constant C may be determined by calculating the potential at the centre, which is the integral of $4\pi r^2 dr \cdot \rho/r$, or $2\pi \rho a^2$. Hence V , at any internal point, is $2\pi \rho a^2 - 2\pi \rho r^2/3$. For an external sphere r , the theorem of Gauss takes the form $-4\pi r^2 dV/dr = 4\pi \rho \cdot 4\pi a^3/3$, so that $dV/dr = -4\pi \rho a^3/(3r^2)$, and $V = \frac{1}{3} 4\pi \rho a^3/r = M/r$, where M is the mass of the sphere. No constant is needed, for the potential (the sum of such terms as q/AP) obviously vanishes when P is infinitely distant from every such point as A . It may be verified from the values found for V that V and dV/dr are continuous at $r = a$; these conditions might have been used as the basis of alternative methods of treating the problem. It should be observed that the potential (M/r) at an external point is the same as if the whole mass of the sphere were concentrated at its centre. Hence a uniform sphere, and similarly a uniform spherical shell, or one with the density a function of the distance from the centre, attracts an external body as if its mass were all at its centre—a result which is important in astronomy.

Magnetic Potential.—The conception of potential is almost as useful for the discussion of fields of magnetic force, due to distributions of magnets and electric currents, as it is in electrostatics. For the development of the theory reference may be made to the treatises on electricity and magnetism named below.

Some solutions of Laplace's equation are given in the article *Spherical Harmonics*.

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Potentilla, a genus of herbaceous perennials, nat. ord. Rosaceæ, found chiefly in the temperate and cold regions of the northern hemisphere, containing about 120 species. They are tall or procumbent herbs, rarely undershrubs, with digitate or unequally pinnate leaves, and for the most part yellow or white flowers. Several species are British. *P. anserina* is also called silver-weed, goose-grass, or wild tansy, the leaves of which are greedily devoured by geese;

and *P. fragariastrum*, barren strawberry. *P. reptans* is a well-known creeping plant with conspicuous yellow flowers. The roots of *P. anserina* are eaten in the Hebrides, either raw or boiled. *P. Tormentilla* is used in Lapland and the Orkney Islands both to tan and to dye leather, and also to dye worsted yarn. It is also employed in medicine as a gargle in the case of enlarged tonsils and other diseases of the throat, and for alleviating gripes in cases of diarrhoea.

Potentiometer, an electrical instrument which is used for current, pressure, and other measurements of high accuracy. It consists of a wire divided up into a number of lengths of exactly equal resistance all arranged in series; the last of them is stretched over a calibrated scale divided into 1000 parts. The current from a secondary cell passes through the wires, and is adjusted by means of adding to or taking away from the circuit resistances, until there is a drop of electrical pressure of one-tenth of a volt over each section of the wire. In arriving at this state, the electromotive force obtained from a standard cell is balanced against the drop of pressure in the instrument over the length of wire corresponding to the nominal voltage obtained from such a cell. After calibration in this way the instrument is ready for use, and the standard cell is disconnected. The use of the instrument in association with standard resistances, in comparing and measuring the magnitudes of resistances, currents, and electrical pressures as well as other physical values which can be gauged in terms of such electrical units, is very common in test-houses and research-laboratories. Standard instruments complete with standard cell and resistances are manufactured by a number of instrument-makers.

Poten'za, a province of South Italy, coextensive with the compartimento of Basilicata, a district nearly corresponding with the ancient Lucania. It has a short western seaboard on the Gulf of Policastro, and a larger eastern coast-line on the Gulf of Taranto, and is traversed by the Apennines. The principal rivers, which all flow eastwards to the Gulf of Taranto, are the Basento, Agri, Sinni, Cavone, and Bradano. Cereals, wines, and oil are produced. The capital is Potenza. Area, 3855 sq. miles; pop. (1915), 489,574 (or 127.0 per square mile).

Potenza (ancient *Potentia*), a city of Southern Italy, capital of the province of Potenza, on a hill (2700 feet) near the Basento (ancient *Casuentus*), which rises on Mt. Ariosa and falls into the Gulf of Taranto near Metaponto. Potenza is surrounded by mediæval walls and outworks.

Potentia, of Roman origin, was successively

destroyed by Frederick II and Charles of Anjou. It lay lower down the plain at the place now called La Murata, where excavation work has revealed many archaeological treasures. During the earthquake of 1857 the modern town fell, and was almost entirely destroyed. Pop. (commune), about 17,940.

Pote'rium, a genus of plants, nat. ord. Rosaceæ and sub-ord. Sanguisorbeæ. *P. Sanguisorba*, or salad-burnet, which grows on dry and most frequently chalky pastures, is the only British species. It is valuable for fodder, and is used in salad. It has pinnate leaves and tall stems surmounted by dense heads of small flowers.

Poti (ancient Phasis), a seaport of Georgia, in the Kutais district, Transcaucasia, on the Rion River and the Black Sea. It has extensive harbour works, and is the seaward terminus of the Samtredi-Poti Branch (41 miles) of the Transcaucasian Railway, by which it is connected with Tiflis (193 miles). Its chief export is manganese ore from the mines of Tchiaturi. Pop. about 21,000.

The Rion rises between Koshtantau and Kazbek, and has a course of 100 miles. The Ingur rises in the highest part of the Caucasus in South-Western Kutais and enters the Black Sea at Anaklia. These two rivers form an enormous delta which extends behind Poti as a vast alluvial plain. Poti harbour is practically unapproachable in bad weather, but has outer and inner basins protected by concrete moles, and possesses an elevator for loading manganese. There is 1500 yards of quays.

Pot Metal, an alloy of copper and lead, used for making various large vessels employed in the arts. Also a kind of stained glass in which the colours are incorporated with the substance by being added while the glass is in a state of fusion.

Potocki (po-tots'ki), an ancient Polish family, taking its name from the castle of Potok, and still holding possessions in Galicia and the Ukraine. Among its most distinguished members was Count Ignazy Potocki (1741-1809), Grand Marshal of Lithuania before the downfall of Poland, and a fellow-patriot of Kosciuszko.

Poto'mac, a river of the United States, which rises in the Alleghany Mountains and is formed by the union of the north and south branches about 15 miles below Cumberland, in Maryland. It forms the boundary between Maryland and Virginia, passes Washington, and after a course of nearly 400 miles flows into Chesapeake Bay, being about 8 miles wide at its mouth. The termination of the tide-water is at Washington, about 125 miles from the sea, and the river is navigable by large ships for that distance. Fifteen miles above Washington the 'Great Falls' occur (90 feet), followed by a series of rapids over 1 mile in length, with a cataract 35 feet high.

Potosí, a south-western frontier department of Bolivia, bordering on Chile and Argentina. Traversing the eastern side of the department north to south is the eastern branch of the Andes (Cordillera de los Frailes and Sierras de Chichas). The western side is an arid, saline waste, belonging to the southern extension of the Titicaca basin. East of the Cordillera the district drains to the Pilcomayo. The department is mainly devoted to mining, gold, silver, copper, and tin being produced. Potosí is the capital; other towns are Huanchaco, Tupiza, and Uyuni. Area, 45,031 sq. miles; pop. about 531,000 (or 7·70 per square mile).

Potosí, a mountain of Bolivia, the 'silver mountain', once the seat of the richest silver-mine in the world, which has been continuously worked since its discovery in the sixteenth century. Altitude, 15,300 feet.

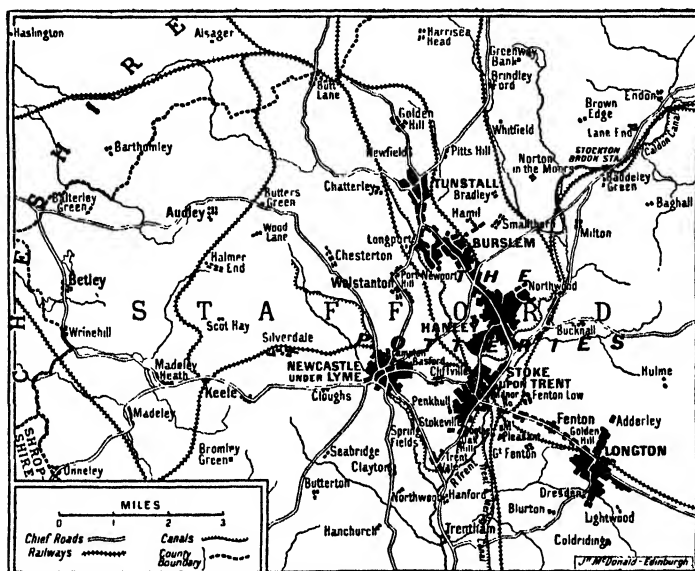
Potosí, a city of Bolivia, capital of the department of Potosí, on the northern slopes of the Cerro (Mt. Potosí), the highest abode of man on the American continent (over 13,600 feet). In the seventeenth century Potosí was the largest town in the New World, and had a population of from 100,000 to 160,000, plus a valuable asset in the richest silver-mine known to mankind. There is a massive granite cathedral, a royal mint dating from 1585, and a Government house. Potosí was founded in 1547, and was made a *villa imperial* by Charles V. The Spanish did not evacuate the town until 1822, although the struggle for national freedom began in 1810. Owing to the closing of mines in the district the city is now in a state of decay. Pop. (1918), 29,795. See *Sucre*.

Potsdam, a town of Prussia, administrative capital of Brandenburg, on the Havel, 17 miles south-west of Berlin; served by the trunk line to Magdeburg. It is one of the handsomest towns in Germany, and is noted for its palaces, which until the Revolution of 1918 were the residences of the Hohenzollern family. The principal palace was built in 1660 and remodelled in 1750. Immediately to the west, outside the Brandenburg Gate (resembling a Roman triumphal arch), are the palace and park of Sans Souci. The palace, a building of one story, erected under the direction of Frederick the Great, has finely laid out grounds, and an orangery 330 yards long. In the same neighbourhood is the New Palace, a vast brick building exhibiting much gaudy magnificence. Other palaces in the environs are the Marble Palace, the Charlottenhof, and the Babelsberg. Sugar, beer, soap, wax-cloth, and optical instruments are manufactured. Potsdam was an unimportant place till the Great Elector selected it as a residence and built the royal palace in the town (1660-71). Pop. 62,000.

Potstone (*Lapis ollaris*), massive talc containing an admixture of chlorite. Its colour is green of various shades; it is greasy and soft, but becomes hard on being exposed to the air. It derives its name from its capability of being made into vases, &c., by turning. It was obtained by the ancients from quarries in the Island of Siphnos and in Upper Egypt. See *Soapstone*; *Steatite*; *Talc*.

Potteries, The, a district of Staffordshire, head-quarters of the English earthenware and porcelain manufacture, comprising the towns of

used is unknown, but it was certainly employed in ancient Egypt. Each type of pottery has its appropriate glaze, the most important being the *alkaline* glazes of silicate of lime or soda, used in Persian pottery; glazes containing *lead*; glazes of *felspar*, very hard and tough, extensively used in China; and *salt* glazes, from the vapour of sodium chloride, used on stoneware. The decoration of pottery in colour also occurs early in its history. The most primitive method was to paint or daub on natural earths, which in the fire develop a considerable range of colour.



Map of the Potteries

Burslem, Hanley, Stoke, Longton, Newcastle-under-Lyme, Tunstall, &c., which unite to form the county borough of Stoke-upon-Trent.

Pottery and Porcelain, terms which together describe all objects made from clay and hardened by heat, porcelain being pottery of which the body is vitrified and translucent. The manufacture of pottery is one of the oldest arts, flourishing in the most primitive societies. Shaping by hand or by pressing into a mould long preceded the use of the potter's wheel; and this has in turn been superseded by the use of absorbent moulds, into which a fluid mixture of clay and water is poured, the latter being absorbed by the mould. The most primitive pottery was hardened by the sun's heat, but the use of fire soon became general; and kilns for firing were known in ancient Egypt, modern improvements mainly consisting in the enlargement of kiln capacity and more even distribution of heat.

When *glaze* (a thin coating of glass) was first

Later, substances containing metal compounds came into use, applied before the glaze was fired, and hence generally called *under-glaze* colours; and in China especially, coloured glazes came into use. A subsequent development, first perfected in China, was painting with enamels on the glaze (*on-glaze* colours). In modern times the use of transfers has largely replaced decoration by hand. With colour, the use of iridescent metallic films (*lustre*) was combined in Persia and Syria, whence it spread to Europe; and since the early eighteenth century the use of the precious metals for decoration has been widespread, especially on porcelain.

Turning to the production of individual countries, each has its own special character and beauty. The pottery of ancient Egypt is notable for its rich colour, especially for a blue derived from copper; while that of classic Greece is marked by its distinguished and graceful form.

The Greek vases are unglazed, and are either *black-figured* (the earlier type, decorated in black on a red or cream ground) or *red-figured* (the later type, the background being filled in with black, leaving the decoration in red). Similar in type but far inferior is the contemporary Etruscan ware of Italy; and though technically very perfect, Roman pottery is artistically behind that of Greece. During the Middle Ages the chief centres of pottery manufacture were in the East, where the traditions of ancient Egypt had to some extent survived. Between the fourth and the fourteenth centuries there developed in Persia and Syria a remarkable art, of which important centres were Rhages and Damascus. Its productions are marked by the application of conventional floral and figure designs in colour to a white ground, the whole being covered with an alkaline glaze, with lustre sometimes added.



Ancient Egyptian Vase, from the original in the British Museum.

Somewhat later came the so-called Turkish pottery, decorated with purely formal designs in brilliant blues, greens, and reds on a white ground. This Eastern pottery was later profoundly to influence European work. In Persia also was produced a species of delicate porcelain; but this substance attained its highest development in China. There, early in the Christian era, a peculiarly hard earthenware of the stoneware type, with a brilliant glaze, was manufactured; and the production of this continued in subsequent centuries, especially during the Ming dynasty (A.D. 1368-1643).

Therein lay the germ of Chinese porcelain, first made during the T'ang dynasty (A.D. 618-907), though the earliest surviving pieces date from the Sung period (A.D. 960-1259). The line between stoneware and this early porcelain is difficult to draw. They are alike in being vitrified; but the fired clay of the former is generally red or brown compared with the white or cream porcelain biscuit, and is rarely translucent. In its final form Chinese porcelain consisted of a mixture in various proportions of infusible white clay (kaolin), fusible felspathic rock (petuntse), and quartz (sand), with a glaze of petuntse, and is known as true or *hard-paste* porcelain. The earlier porcelain was decorated with glazes of various colours, of which the famous *Celadons* (blue- or yellow-greens) are the best known and highly prized. In the early days of the Ming dynasty there was a great improvement in whiteness and translucency; and partly under

Persian influence the use of painted decoration under the glaze developed. By the fifteenth century the well-known blue-and-white ware and the use of under-glaze red had attained perfection, likewise the egg-shell and perforated porcelain; and towards the end of the sixteenth century the use of enamel on-glaze colours appeared. After a brief period of decline a revival began with the reign of K'ang-Hsi (1662-1722), which lasted to the end of the eighteenth century. From this period date some of the finest examples of Chinese work. Older methods of decoration were revived and new ones invented, such as *powder-blue* grounds, peacock-blue, au-bergine-purple, iron-rust, and tea-dust glazes, and the schemes of on-glaze colours known as *famille verte* (wherein green enamel predominates) and *famille rose* (mainly rose and purple).

In Japan, under Chinese influence, the manufacture of porcelain became important in the seventeenth century. Notable types are: the *Kakiemon* ware, sparsely decorated on a white ground with floral sprays, birds, and animals in red, blue, and green, sometimes called *Imari* ware from the place whence it was exported to Europe; *old Imari* ware, with more crowded decoration in blue, Indian red, and gold; *Hirado* ware, with figure subjects in pale-blue; and *Kaga* porcelain, noted for the brilliancy of its colour.

Meanwhile in Europe, where the potter's art had languished, contact with the East pro-



Etruscan Vase of Smoked Black Ware with Ornaments in Relief applied from a Mould—about 600-500 B.C.

duced a revival. In fourteenth-century Spain *Hispano-Moresque* pottery appears, marked by a brilliant, opaque, white glaze (made by mixing tin oxide with a lead glaze), and by decoration with geometrical and foliage patterns often enclosing heraldic devices, combined sometimes

with lustre. This ware inspired in the fifteenth century the *majolica* of Italy, in which tin glaze formed the ground for painted decoration with or without lustre. The chief centres of manufacture were Deruta, Gubbio, Urbino, and Faenza, each using a characteristic type of decoration and colour. In the sixteenth century the use of pictorial decoration reproducing paintings and engravings became general, and began a decline from which there was no re-

ing to porcelain, in which were made the familiar imitations of Greek and Roman ware, with ornament in relief.

The influence of the East is traceable in all European pottery, but it is most evident in porcelain. In Saxony, at the beginning of the eighteenth century, Böttger produced a porcelain akin in appearance and character to that of China, which formed the basis of *Meissen* (incorrectly called *Dresden*) ware. The early



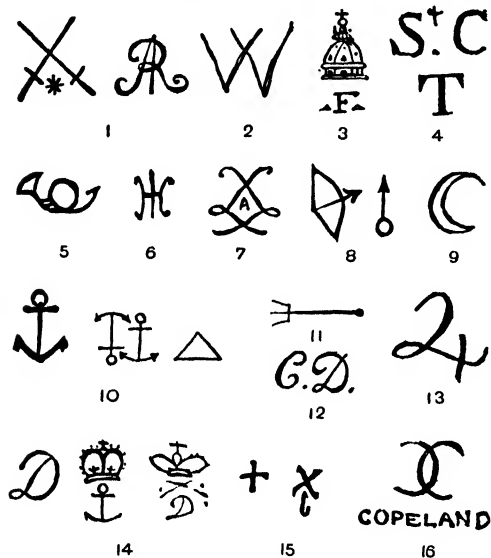
Greek and Roman Vases

- 1, Stamnos inscribed with name of artist Polygnotos. 2, Amphora by same artist. 3, Krater, Aretine ware, first century B.C. 4, Oinochoe. 5, Kylix, 508 B.C. 6, Vase from Southern Gaul, A.D. 40-70.

covery. Elsewhere in Europe progress is marked by the work of Bernard Palissy in France, which is, however, only a perfected type of ordinary pottery; but in the seventeenth and eighteenth centuries France became the centre for the production of *faïence*, a tin-enamelled ware gaily and tastefully decorated in floral and grotesque patterns. In Germany the manufacture of brown and grey *stoneware*, decorated in relief, developed; and in Holland about 1600 appeared the tin-enamelled *Delft* ware, generally decorated in blue, which was exported in large quantities and had many imitations in other countries. In seventeenth-century England, for example, Bristol and Liverpool were centres for such imitations. In Staffordshire, however, a native pottery art grew up, represented by the white-and-drab salt-glazed ware, and by an earthenware made white in substance by the use of selected clays. In this development Josiah Wedgwood played a prominent part. Well known is his *Jasper* ware, an unglazed pottery approxim-

pieces imitated Chinese models in form and decoration; but from 1730 to 1775 a distinctive style evolved, at first resembling Imari porcelain, then uniting rococo curves and fantastic ornament with painted scenes in the manner of contemporary artists. Other characteristic products were small figures or groups in biscuit or colour. Meanwhile in France, at Rouen and St. Cloud, a substance had been manufactured resembling porcelain in its translucency, but which was virtually glass holding clay in suspension. This is artificial or *soft-paste* porcelain, the material of all earlier French porcelain. At Chantilly charming work inspired by Imari ware was produced in this material; but it was the factory founded in 1740 at Vincennes and afterwards moved to Sèvres which became the chief centre of production. After a brief period of submission to Eastern influence the porcelain of Sèvres first shows a style of rococo curves and fantastic ornament, then one of greater restraint in form and decorative motives under the influence of classic art. At the same

time, by the use of colours (notably the *rose du Barry*) and gold, its decoration became increasingly lavish and ostentatious. Other characteristic products were the charming statuettes in biscuit, from models by leading sculptors of the day. In 1763 the secret of true porcelain was discovered; and this tended ultimately to displace other types, and to hasten the artistic degeneration which had already begun. In direct imitation of French work were the porcelains of eighteenth-century Italy, typified by that of *Capo-di-Monte*, whence in turn came



Marks of Famous Porcelain Factories

1, Dresden, 1736 and 1709-12. 2, Berlin. 3, Florentine. 4, St.-Cloud. 5, Chantilly. 6, Capo-di-Monte. 7, Sèvres. 8, Bow, two forms. 9, Worcester. 10, Chelsea, three forms. 11, Swansea. 12, Coalport. 13, Plymouth. 14, Derby, three forms, last Crown Derby mark 1780. 15, Bristol, one mark about 1773. 16, Copeland.

many of the models and workmen for the factory at *Buen-Retiro*, near Madrid.

In England the earlier porcelains are typified by those of Bow and Chelsea, which are of soft-paste, and in form and decoration owe everything to Eastern and Continental influence. The two factories were ultimately absorbed by the Derby factory, whose products mark no artistic advance, but reflect the growth of the neo-classic movement. At Worcester, also, foreign influence was strong, and there was first developed the method of transfer printing. About 1800 Spode perfected a method of preparing porcelain by using bone-ash in place of glass, and henceforward this became the distinctively English porcelain, which is easier to handle and less fragile than the older soft-paste. The nineteenth century has seen immense growth

in the scale of pottery manufacture, but has produced little but mechanical and inferior repetitions of earlier designs.—BIBLIOGRAPHY: Technical: A. Brogniart, *Traité des arts céramiques*; W. Burton, *Porcelain*. Descriptive and Historical: H. B. Walters, *Ancient Pottery*; D. E. Fortnum, *Majolica*; M. L. Solon, *Old French Faïence, Ancient Art Stoneware, and Old English Porcelain*; A. H. Church, *English Earthenware*; S. W. Bushell, *Oriental Ceramic Art*; E. S. Auscher, *French Porcelain*.

Pottery Manufacture. The successful manufacture of pottery is to-day a highly scientific process requiring the greatest care and special knowledge of chemistry, engineering, and factory administration.

The general term 'pottery' includes earthenware and chinaware. The processes of manufacture in both classes are roughly the same, but differ in detail and composition of bodies. Earthenware and semi-porcelain bodies consist of ball clay, china clay, flint, and Cornish stone. The first two items give the clay its plasticity in working; the flint and stone are the muscle of the body, and give it its strength. In china the ball clay is eliminated, and ground bone is used in its place. This gives the translucent appearance and the superior whiteness. The above components vary in their proportions according to the class of goods it is intended to manufacture.

The first process is the calining of the flint, to get rid of impurities. It is then ground in cylinders or in pans. A pan is a large vat, paved with hard chert stones. Blocks of stone are kept moving over the bottom of the pan by means of a powerful revolving shaft. The Cornish stone is also ground, water being added in each case. The ball clay and china clay are crushed or blunged in separate blungers, water also being added. Inside these blungers are large revolving arms which reduce the materials to a fine milky substance.

When all these ingredients are ground sufficiently fine, they are run off into a 'mixing are', the correct proportion of each being carefully measured and a cobalt stain being added. This slop material is then pumped by powerful pumps into machine-presses which squeeze out the water, leaving the clay substance. Although now solid, it is not yet fit for the potter, as at this stage it is not sufficiently plastic. To obtain the requisite plasticity it is passed through a pug-mill, from which it comes out ready for use by the potter.

The next step is to shape the clay. The *potter's wheel*, one of the most ancient of tools, may be used for articles of rounded form. The wheel resembles an ordinary turning-lathe, but the surface of the chuck is horizontal instead of

vertical. The chuck is in fact a revolving table, in the centre of which a piece of clay is placed, which the potter, or 'thrower' as he is called, begins to shape with his hands. The clay rises in a spiral column, is pressed down, allowed to rise again, and finally brought down to be centred or trued. By pressing his thumbs into the clay, the thrower next forms a cylinder, which under his manipulation soon assumes the contour he is aiming at. The article, thus roughly shaped, is then detached from the revolving table and dried, after which it is taken to a lathe and polished with a tool. The handles and other appendages are fitted on at this stage.

Ware of all kinds is now generally made in a mould. Each article made has its own mould, which is made of plaster, run very hard. The life of a mould for good-class ware is only about four months, owing to the action of the clay on the mould surface. It is necessary to have sufficient moulds for a complete 'round' of ware, as every article made requires a separate mould. The top surface of the mould is made according to the article wanted, and the bottom of the mould is made to fit a jolly head. Cups, bowls, and other 'ringware' are jollyed inside, that is to say, the moulds fit inside the head. Flat ware is jollyed outside, the mould fitting *over* the head. The tool which is to shape the article, either inside or outside, fits into the jolly. This tool is usually termed the 'rib'. The blocks of clay are cut into strips by the maker, and for flat ware a sufficient amount of the clay is flattened out (into a 'bat') to cover the surface of the mould. It is then run down with the tool, which forms the back of the article, the front being formed by the mould. For cups, bowls, &c., the clay is made into a ball and thrown into the mould and jollyed.

The ware on the moulds is next put into heated drying-chambers until it is dry enough to come off the moulds, after which it is carried into a 'green room', where it is assembled for placing into the ovens. Ware is first placed in saggars, which are receptacles shaped like hat-boxes made out of special clay and marl and fired, and are of convenient sizes for the various articles made. These saggars are placed tier upon tier in an oven which is completely sealed up and fired for a period of about fifty to sixty hours. The oven is then allowed to cool down, the ware is drawn, and transferred to the 'biscuit warehouse', the ware at this stage being known as 'biscuit'. It is now quite white, but is absorbent or porous, water being able to soak through in a few minutes.

In the biscuit warehouse the ware is sorted and brushed, and is made ready for the next process. This varies according to the type of finished article which is wanted. If this is

plain white ware, the biscuit is sent direct to the dipping-house, where it is dipped in tanks containing glaze. This gives the fine glossy appearance of the article as seen in the home. If the ware is wanted for decoration, the biscuit ware is sent up to the printing-shop. The prints are taken off engraved copper plates, the latter being filled with colour according to requirements. The prints are then transferred on to the ware, hardened on in a muffle, and then sent into the dipping-house for glazing.

After the ware is dipped, it is again put into saggars for placing in 'glost ovens'. This time each article is separated by stilts or spurs, as without this precaution the ware would stick together during firing. The length of time required for this firing is about thirty hours. After cooling, the oven is drawn and the ware selected in the 'glost warehouse', where it is laid off ready for packing to the distributor. The goods are now ready for use, but further 'on glost' decorations can still be made with 'enamel' colours if wanted. The colour is 'brought up' and hardened on in a glost muffle. Thus the more highly decorated goods require more firings. The complete time required for making an article varies with the decoration wanted. It is difficult for the everyday user to understand that even the cheapest white cup requires from twenty-one to twenty-eight days to make.

Potto (*Perodicticus potto*), an animal of the lemur sub-order inhabiting West Africa, and averaging about 8 inches in length. The name is also given to the *Kinkajou* (q.v.).

Pott's Disease, or **Angular Curvature**, is tuberculous disease of the spine. It was first accurately described by Pott towards the end of the eighteenth century. The tuberculous condition arises in the fore-part of the spinal vertebræ, which become more or less destroyed, thus leading to a sharp curvature of the spine in the affected region. The outstanding features are: (1) *Pain*, which at first may only be brought out by careful examination, and is of two types—local, arising in the region of the affected vertebræ, and referred pain, due to pressure on, or irritation of, the nerves as they emerge from the spinal column. This pain is referred to the region of the body which these nerves supply. (2) *Rigidity* of the spine, which arises from the attempt to keep fixed the painful part; hence the pain in attempting to touch the ground keeps the back stiff and straight and bends the hips and knees. (3) *Deformity*, which occurs as a result of bony union between the damaged vertebræ, the extent of the deformity depending chiefly on the number of vertebræ involved. There is a marked bulging of the spine at the affected region, with compensatory changes in

the thorax; the breast-bone becomes convex, while the ribs are crowded together. In a severe case the patient is stunted in growth, and presents the appearance of the typical hunchback.

(4) *Abscess-formation*, which occurs first in front of the vertebrae and then spreads to the sides of the spine, and finally burrows in various directions according to the portion of the spine affected. Thus there may arise abscesses in the neck, in the chest-wall, in the lumbar region, or the psoas abscess in the groin or thigh. When such abscesses occur, symptoms arise from pressure and irritation of the surrounding parts, and a hectic type of temperature is produced. (5) *Paralysis* of the lower part of the body, which only arises in severe and neglected cases, and is due to pressure on the spinal cord in rapid and acute forms of the disease.

When left to itself, Pott's disease as a rule progresses; the bone lesions become extensive, and abscesses are likely to form. If treated early and efficiently, repair by bony union takes place, and the disease is arrested, though some damage is inevitable. The chief essential in treatment is early and complete immobilization of the spine by mechanical support—by plaster jackets, splints, or similar contrivance. The patient suffering from Pott's disease is liable to be affected by tuberculosis of other organs, and preventive measures against tuberculosis should always be adopted.

Pottsville, a city of Pennsylvania, United States, the county seat of Schuylkill county, on the Schuylkill River; served by the Lehigh Valley, the Pennsylvania, and the Philadelphia & Reading Railways. It is in the centre of the great anthracite coal region, and has furnaces, forges, rolling-mills, machine-factories, and railway repair-shops. John Pott founded the city in 1804. It was a centre of the Molly Maguires (q.v.), and became the county seat in 1851. Pop. (1920), 21,785.

Pouched Mouse, or **Pocket Mouse**, a genus of American rodents with large cheek-pouches, long tails, and hind-legs specially adapted for leaping. The best-known species (*Dipodomys phillipsi*) lives in the desert parts of California, and subsists chiefly on roots, grasses, and seeds.

Poudrette (pō-dret'), the name given to a powdery manure obtained from night-soil. It takes a long time to prepare, is pulverulent, of a brown colour, and almost inodorous. Thon's poudrette has the following percentages of useful constituents: nitrogen, 4 to 6; phosphoric acid anhydride, 8; potash, 2 to 3. It is liable to contain disease germs, is difficult to manufacture, and unlikely to be used on a large scale.

Poughkeepsie, a city of New York, United States, the county seat of Dutchess county, on Hudson River; served by the New York Central

& Hudson River, the New York, New Haven, & Hartford, the West Shore, and other railways, and by Hudson River steamboats. There is a cantilever bridge of 6767 feet in length (2260 feet without approaches) spanning the Hudson at this point. Poughkeepsie is famous as the 'city of colleges', which include Vassar College (1878) for women, Riverview Military Academy (1836), Putnam and Lyndon Halls (girls), and St. Faith's (1888), removed from Saratoga in 1904. Poughkeepsie was founded by Dutch settlers about 1698, and was the seat of the Convention of 1788, at which the Federal Constitution was adopted. It became a city in 1854. Pop. (1920), 35,000.

Poultice, or **Cataplasm**, is a soft, moist preparation applied externally to some part of the body, and generally put on as hot as possible. It is usually made of linseed-meal, oatmeal, or bread-crumbs formed into a paste with hot water, then enclosed in thin cotton or linen, and applied to the skin. Mustard and other remedies may be added to induce special effects.

Poultry and Poultry-farming. Poultry is a general name for all domesticated birds bred for the table or kept for their eggs. The birds commonly included in this designation are the common fowl, the pea-fowl, the guinea-fowl, the turkey, goose, and duck, but it is the first of these that is mainly dealt with here.

In poultry-farming for profit it is necessary to classify the various breeds of poultry in a manner suitable for practical guidance as apart from the classification of the naturalist; and for this purpose three main factors are to be considered, viz. egg-production, meat-bearing properties, and maternal instincts. No breed of poultry can be expected to excel in both egg- and meat-production, and increased development in one quality will certainly be at the expense of the other. The smaller fowls are usually the most prolific egg-producers, and, as a general rule, the larger the bird the lower the productivity. Nor does size of skeleton and bone necessarily indicate an abundance of flesh, for in this case also medium-sized fowls are supreme, producing by far the greatest amount of flesh in proportion to the total weight. The properties of both egg- and meat-production are combined in a 'general purpose' or 'utility' breed of birds, which, while they are not so prolific as non-sitters, are disposed to lay better in winter and possess much superior laying qualities to the table breeds, although they cannot compare with them in either the quality or the quantity of the flesh produced. These utility breeds attain a fair size, and are more marketable than non-sitters. As a result of these considerations and of prolonged experi-

ment, the best-known races are divided as follows:

Laying and Non-sitting.—Ancona, Brackel, Campine, Hamburg, Houdan, Leghorn, Scotch Grey, Redcap, Minorca.

Table.—Courtes Pattes, Bresse, Crève-cœur, Dorking, Game, Indian Game, Sussex, La Flèche.

Utility.—Faverolles, Langshans, Wyandottes, Orpingtons, Rhode Island Reds, Malines, Plymouth Rock.

Laying Ducks.—Indian Runner and Pekin.

Table Ducks.—Aylesbury, Blue Swedish, Hutegeem, Merchtem, Rouen.

All turkeys and geese are bred primarily for table purposes.

Systems of Farming.—In the strict sense of the term, 'poultry-farming' is not synonymous with 'poultry-keeping'; nor does it necessarily mean the systematic use year after year of ground covered with poultry-runs, housing large numbers of fowls. This acceptance of the term 'poultry-farming' is certainly misleading, and the term must be regarded, in the wider sense, as meaning that poultry is the primary consideration, but that farming, including the tillage of the soil, enters into the business. These considerations being kept in view, there are four different systems in which fowls can be kept both profitably and in health, viz. free range, extensively, semi-intensively, and intensively. In free-range systems the fowls are allowed absolute liberty to wander over an unlimited area. The extensive method consists in the erection of large runs provided with roosting-houses. The fowls are fed and live entirely inside the runs. Semi-intensive methods aim at compactness in housing. A large number of birds (400 to the acre) are kept in houses provided with scratching-sheds, inside of which all grain is scattered and food is laid down. Attached to the houses are small runs in which the birds may take the requisite amount of exercise. By this method it is claimed that birds may be kept indoors under summer conditions throughout the winter, enjoying exercise in the runs when the weather is favourable. The intensive system has for its object the maintenance of fowls in a similar manner to cage-birds; this is to say, they are kept in complete confinement. Geese, ducks, and turkeys, however, cannot be kept under such conditions.

Feeding of Fowls.—In its primitive state the hen did not lay an egg a day, but since its adoption by man for domestic purposes it has been compelled to do so by systematic over-feeding. The science of poultry-feeding, therefore, may be summarized broadly as the art of forcing a hen to take an absurd quantity of

egg- and flesh-producing food, without exactly killing her. There are two great schools among modern poultry-farmers, the 'wets' and the 'drys', the former favouring the system of wet mash feeding, and the other pinning their faith to dry meals and grain. Both systems have shown good results under expert manipulation, although this is not admitted by the trade organs of either party. *Albuminoid Ratio.*—All methods of scientific feeding are dependent for their ultimate value as stimulants to production upon a properly balanced and carefully administered diet, comprising the three great classes of nourishing constituents, albuminoids (proteins), fats, and carbohydrates, in their proper proportions. A hen cannot produce eggs, flesh, and healthy chickens on a diet of worms, ham-rinds, and household scraps, which are so often employed with positively disastrous results. The flavour of the egg and its food value, as well as the quality of the flesh, are dependent upon the feeding of the bird that is producing them, and for the purpose of maintaining definite standards a test known as the 'albuminoid ratio' is employed. To work out the food value of any given food, it is necessary to find what proportion the protein matter present in the food bears to the fats plus the carbohydrates. To reduce the fats to carbohydrate value they are multiplied by $2\frac{1}{4}$ ^(a), and the result is added to the carbohydrates. This total divided by the proteins gives the albuminoid ratio. For example, a diet consists of wheat. A food table shows the value of wheat to be as follows:

Albuminoids, 13.0.
Fats or oils, 1.5.
Carbohydrates, 66.4.

Fats multiplied by $2\frac{1}{4}$ = 1.5×2.25 = 3.375. Carbohydrate value of fats.
 3.375 added to 66.4 (carbohydrates) = 69.775 . Total carbohydrate value of wheat.
 69.775 divided by 13.0 (albuminoids) = 5.37 . Albuminoid ratio of wheat.

The albuminoid ratio, then, is roughly 1 in $5\frac{1}{4}$. A perfect poultry food has a ratio of 1 to $3\frac{1}{4}$ for laying hens, and 1 to $4\frac{1}{4}$, or 1 to 5, is considered a good ratio for other classes. In calculating the ratio for a complete poultry food it is necessary to take the values of the ingredients separately, and add up the total albuminoids and total carbohydrates before proceeding with the above calculation. It should be noted that a hen in full lay eats twice as much food as at any other period, and must be kept plentifully supplied with fresh, clean, cold water, as well as oyster-shell or a suitable equivalent for the supply of the lime required in making the egg-shell. Grit is also a vital necessity. It

(a) This is a handy approximation, and may be taken as a constant.

promotes assimilation and digestion in the gizzard.

Amount of Food.—Over-feeding is to be avoided, for not only does a fat hen cease to lay, but over-stimulating food or an excess of food is the cause of most general diseases and of the majority of deaths from natural causes. The amount of food required per hen can only be judged by inspection. No two flocks are alike, and no flock demands an equal amount on two successive days or even at different meals. Hens that are not laying well or are moulting (i.e. casting their feathers after the summer season) should not receive a full supply of food; the nature of the range and the season of the year also exert considerable influence upon the amount of food required. It is general in Great Britain to give three meals or more in a day. Some supply 'mash' in the morning and grain at night; others reverse this principle. A good system provides for an early morning mash, midday grain ration, grain ration for 'tea', and a very small quantity of grain again before roosting-time. Twenty minutes are allowed for the consumption of the morning mash. Two ounces per head is the average grain ration (wheat, oats, maize, buckwheat, &c.), and green-stuffs, grit, shell, and water are always kept at hand. Where skimmed milk is obtainable, adult fowls derive great benefit from partaking of a few good draughts, but the meat (mostly protein) ration in the mash must be cut down or cut out altogether where milk forms a part of the diet, for the casein of milk is a powerful nitrogenous or protein (albuminous) substance. Fish-meal tends to impart a fishy flavour to the eggs, and should not be employed indiscriminately.

Soil.—The supreme question in the United Kingdom for all who take up poultry-farming is not climate but soil. While eggs can be produced on all soils, the best eggs are the product of hens living on the best soils. Chickens grow slowly upon cold, heavy land, and such conditions are naturally against the production of table poultry or the quick raising of turkeys, both of which require a kindly soil, one which is naturally dry but is at the same time prolific in its vegetable growth. Experience has shown that it takes from three to four weeks longer to raise a chicken to killing-age upon heavy land than upon lighter soils, and when fully grown it is not nearly so good in quality of flesh. Eggs may be produced in any part of the country, but there are considerable limitations in the case of first-class table fowls.

Breeding.—The improvement in stock of every kind is almost wholly dependent upon special breeding-farms which also introduce crosses of specific qualities, and this is especially the case

in poultry-farming. Improvement in the qualities of fowls is not a part of the ordinary work of poultry-farming, and is generally left entirely to specialists and showmen. What vitally concerns the small farmer is the propagation of his stock and its increase in numbers, value, and productivity. Eggs are not 'set' by progressive farmers nowadays, who cannot afford to lose a hen for three weeks, and incubators of varying sizes and different construction are almost exclusively employed. When a hen becomes 'broody', or 'clockin' as it is called in Scotland, she is cooped up in a coop made of spars within sight of her pen, and speedily recovers her laying powers when subjected to the persuasion of a plentiful supply of fresh, cold air, for a hen will not sit where she cannot generate heat. This method is humane and simple, and has proved that there is only one cure for broodiness—great discomfort.

It has been said that 'the cock is the principal bird in any pen', and undoubtedly he plays a vital part during the breeding season. A yearling cock should generally be mated with second-season hens, although breeders are not unanimous on the question. The number of hens to one cock depends on the breed, age, and vitality of the cock, and no hard-and-fast rule can therefore be laid down. A heavy-breed cock (e.g. Rhode Island Red, Orpington, Plymouth Rock, Sussex, &c.) should have from six to twelve hens, and in the lighter breeds as many as twenty hens may be allotted on a free range, with a reduction to eight or twelve when in confinement. As a rule the influences exerted by the parents on the progeny are widely divergent, but, generally speaking, the male influences shape and exterior build and appearance, while the female controls temperament, size, habits, and constitution. For many reasons it is not customary to recognize eggs as being 'fertilized' until a week or ten days have elapsed from the date of mating. Eggs for hatching should always be stored with the broad dome uppermost. They should be of average size, with smooth shells and a uniformity in shape, and should be kept in a dry place at a temperature of between 41° and 59° F. The fresher the eggs when incubated the stronger, and healthier generally, will be the chickens they produce. During incubation the eggs should frequently be tested. Broomhead says: "Test the eggs after they have been incubated seven days. If all has gone well, the germ with the encircling membrane then presents the appearance of a semi-transparent circular spot floating at the top of the egg when held sideways, and at the seventh day it extends over nearly one-half of the interior surface of the shell. If the process of hatching is perfectly satisfactory, this 'spot' floats round in the egg

when the latter is turned in the hand. Should the germ apparently adhere to the shell when the egg is first removed, it will probably free itself when the egg cools; if not, there is too little moisture, and danger to the embryo. It is at this stage that what is sometimes described as the 'spider' may be seen. This spider-like appearance is produced by the dark eyes of the chick—developed to an abnormal extent—forming a resemblance to the body of a spider, the larger blood-vessels circulating from the body through the enveloping membrane and forming the spider's legs. A few days later the enveloping membrane expands still more, thickens, and is covered with minute blood-vessels. The egg then presents, throughout the greater part of its surface, an opaque appearance. The small end and perhaps a part of one side are so far transparent that the light can be seen through them. This, however, gradually decreases, until at about the sixteenth day the egg is quite black, except at the large end, where the air-vesicle, now considerably enlarged, can be seen." By these signs the poultry-farmer is enabled to judge the progress of incubation and to shape his plans accordingly. The average period of incubation is twenty-one days.

BIBLIOGRAPHY: W. W. Broomhead, *Poultry for the Many*, which is quite the best general treatise on poultry-farming extant; also articles in *The Standard Cyclopedia of Modern Agriculture*.

Pound, in English law, an enclosure for keeping cattle which have strayed on another man's ground, until they are redeemed. A pound may belong to a parish or village or to a manor.

Pound, an English weight of two different denominations, *avoirdupois* and *troy*. The pound *troy* contains 5760 grains, and is divided into 12 ounces; the pound *avoirdupois* contains 7000 grains, and is divided into 16 ounces. The *pound*, or *pound sterling*, the highest monetary denomination used in British money accounts, and equal to 20 shillings, was so called from originally being equal to a quantity of silver weighing one pound. The pound is strictly a money of account, the coin representing it being the sovereign.

Poussin (pō-san), Gaspar, French landscape-painter, born in Rome in 1613, died there 1675. His real name was Dughet, but he took the name of his brother-in-law Nicolas Poussin, whose pupil and protégé he became. He lived mostly in Rome or its neighbourhood, and concentrated on a romantic type of landscape-painting, in which figures played a quite subordinate part. He possessed extraordinary facility of execution, so that his works are very numerous, specimens being found in all the chief collections in Europe. He is well represented in the National Gallery.

Poussin, Nicolas, French painter, born near Les Andelys in 1594, died at Rome 1665. He studied in his native place and at Paris, where he had acquired some reputation when, in 1624, he went to Italy to improve himself in his art. There he worked in the studio of Domenichino, and studied anatomy, perspective, and the art of classical antiquity with singular intensity. In Rome poverty and ill-health hampered him for a time; but he was assisted by a Frenchman, Jacques Dughet, and by him tended through an illness brought on by overwork. In 1630 Poussin married Dughet's daughter. Eventually he found liberal patrons in Cardinal Barberini, for whom he painted the *Death of Germanicus*, strongly under the influence of Giulio Romano; and in the Cavaliere Cassiano del Pozzo, who commissioned the celebrated *Seven Sacraments*, now at Belvoir Castle. In 1639–40 he painted for Cardinal Richelieu four *Bacchanals*, of which one (*The Triumph of Silenus*) is now in the National Gallery. In 1639 he was invited to return to France, and he became first painter to Louis XIII, with a pension of 3000 livres. From 1640 to 1642 he resided in Paris, producing there cartoons for tapestry and a series of paintings for the great gallery of the Louvre; but the rivalry of French painters and the want of appreciation of his works caused him to return to Rome, where he lived until his death. During this period his greatest work was done, including a second set of *Seven Sacraments*, *Shepherds in Arcadia*, and *Phocion*; followed by *The Death of Phocion* and *Polyphemus*. Landscape played an increasingly great part in Poussin's work. The colour of his early work is apt to be hot and heavy; but for massive, logical, coherent design he is unsurpassed, and his influence on art, especially French art, has been profound. His early work is well represented in England, notably in the National Gallery and at Dulwich. The Louvre contains the most complete collection of his later pictures.

Powan (*Coregonus clupeoides*), a fish inhabiting Lochs Lomond and Eck, in Scotland, and also known as the freshwater herring. It is of the same genus as the pollan and vendace (q.v.).

Powell, Sir Robert Stephenson Smyth Baden-, British soldier, born in 1857. Educated at the Charterhouse, he joined the 13th Hussars in 1876 and served in India, Afghanistan, and South Africa; was assistant military secretary in South Africa from 1887 to 1889, and in Malta from 1890 to 1893; on special service in 1895 in Ashanti in command of native levies, and breveted lieutenant-colonel; was chief staff-officer in the Matabele campaign, and became brevet colonel; from 1897 to 1899 was in command of the 5th

Dragoon Guards as lieutenant-colonel. In the South African War of 1899–1902 he distinguished himself by his defence of Mafeking from Oct., 1899, till May, 1900, and was made major-general. He was Inspector-General of Cavalry from 1903 to 1907, and was made K.C.B. and K.C.V.O. in 1909, and a baronet in 1921. He is the founder of the organization of Boy Scouts. His works include: *Pig-sticking, Cavalry Instruction, Downfall of Prempeh, Matabele Campaign, Scouting for Boys, My Adventures as a Spy, Girl-Guiding, and Rovering to Success.*

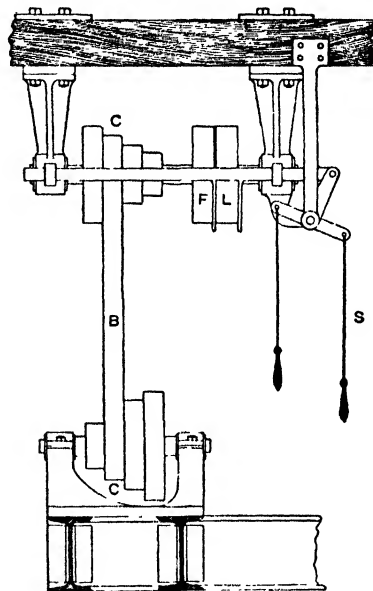
Power-looms are mechanically or electrically driven machines of various types in which fabrics are woven. Water is occasionally used as the motive-power, and so are gas and oil. The modern methods of driving are, however, by steam and electricity. See *Weaving*.

Power of Attorney, in law, a written instrument whereby one person is authorized to act for another as his agent or attorney, either generally or in a special transaction.

Power Transmission. The distribution of power from its place of generation to the points of usage can be effected in many different ways, such as mechanical, by means of some type of mechanism; electrical, either by means of direct or alternating currents; by hydraulic means; or by compressed air. In every case there is some point where the generation of power can be effected most economically, which may be termed the 'centre of gravity' of the load. Frequently it is not possible to generate at this point because of lack of natural resources or a dearth of suitable sites at reasonable prices. The power obtained from the fall of water may be conveyed to distant cities. In this case it is most unlikely that the load centre is anywhere near the station, but the location of the available water-supply is the sole determining factor in selecting the point of power generation. If power is to be generated by steam engines or turbines, the provision of cheap and plentiful condensing water will considerably affect the determination of the site of the power station and the magnitude of the running costs. The various prime movers are dealt with in the articles *Steam-engine; Turbines, Steam; and Internal-combustion Engines*. Hydraulic power transmission is treated of in the article *Hydraulics and Hydraulic Machinery*. The transmission of power by compressed air is dealt with under the headings *Pneumatic Power Transmission* and *Compressed Air*.

Mechanical transmission of power is common in engineering, chemical, and other industrial works. In this case the power, whether obtained from an engine or electric motor, drives main shafting by means of belts and pulleys (see *Pulley*), and the various machines receive their

drives from the shafting. Suitable speeds of running for shafting are, for metal-cutting machines, 200 revolutions per minute; for wood-working machines, 250 revolutions per minute; and for cotton and woollen mills 300 revolutions per minute. Counter-shafts are interposed between the main shafts and the machines, and when fitted with cone pulleys make possible a variation in the speed of running. The use of fast and loose pulleys on the counter-shaft serves to allow the machines to be stopped and started at will. In cotton-mills rope driving is very



Countershaft Drive

c, c, Cone pulleys. B, Belt. F and L, Fast and loose pulleys. S, Striking gear.

common. The pulleys are provided with grooves in which the ropes run. Ropes of hemp or manila do not wear so well as cotton. With large pulleys, small cotton ropes commonly last twelve or more years. Chain driving is highly efficient, is positive, and there is no possibility of slip. This system gives a calculated speed ratio exactly, and whether the chains are tight or slack they will grip the sprockets. Little space is taken up by chain drives, which are very suitable for distances too long for gearing and too short for belts.

The efficiency of transmission of power by shafting is much lower than with electricity and separate motors for each machine, the values being about 40 per cent and 65 per cent respectively. The use of separate motors for each machine has much to recommend it. The machine shop is then free from all overhead shafting, and there is absolute freedom to choose sites for

machines to suit the continuous progress of the work upon the billets.

Electrical Power Transmission.—The lines of development of modern schemes of electricity distribution have followed the progress in improvement of design of the individual components of the plant. In early days electricity was generated at comparatively low pressures by dynamos coupled to slow-running steam-engines. Later the high-speed steam-engine became a practical proposition as a result of the experimental work of R. K. Morcom and P. Willans. This step was of considerable importance, as dynamos could then be designed for higher speeds of running, for which they were eminently suited. When the steam-turbine was developed another change of conditions was produced, as the turbine must be run at a very high speed if economical working is required. With the increase in generator speeds and the sizes of units the whole design of a power station was changed. The old arrangement of separate boilers for each engine set, either as completely separate units or with a ring-main system of steam pipes to permit the connection of any boiler to any engine, gave place to the concentration of power generation in some few large units each fed with steam from a bank of boilers. Power-station design became largely a question of providing boiler space, and in some large stations in congested areas the boiler-house was divided into sections on two or more floor-levels to keep down the area requirements of the station. The first change in systems of distribution was from simple low-pressure transmission, with its heavy first cost because of the amount of copper in the cables, to the three-wire system, with pressure differences between the two outer mains and the neutral just as great as is permitted under the Government regulations. The first cable is at a potential as high above that of the neutral or second as that of the third is below it. The neutral wire only carries the out-of-balance currents, which are never considerable, and it is usually made of half the cross-section of the others. The weight of copper in the cables of a three-wire system is only five-eighths of that required for a simple two-wire system transmitting an equal amount of power. A five-wire system of distribution was installed in the centre of Manchester, but it is doubtful whether the system has any appreciable advantage over the three-wire system. Electrical transmission from central stations at high pressure, and usually by alternating currents, to sub-stations where the pressure is reduced to a value within the limits prescribed in the Government regulations, and where necessary the electricity is converted into the continuous-current type, later became standard practice. All the large power schemes in this country work

on this system, which permits economical transmission over large areas, with a considerable amount of freedom in the selection of a site for the generating station and economical generation by large power units. The present tendency in electrical power-station design is towards the use of superheated steam at very high pressures in turbines of very great power. The economic advantage of using very high pressure steam has many advocates, but the additional expense of the production of such steam in boilers of high first cost and maintenance charges, together with the increased cost of the equipment necessary for its transmission and use, must be set against the financial gain arising from any slight increase in thermodynamic efficiency. An endeavour is being made to link up the electricity supply systems in areas, a number of which have already been defined by the electricity commissioners.

The Glasgow Corporation electricity scheme may be cited as a modern example of electricity generation and transmission. In the new power station at Dalmarnock the turbo-alternator units have a normal capacity of 15,000 kilowatts, but can carry a load of 18,750 kilowatts continuously. Electricity is generated at 6500 volts, and is passed to a transformer from which a supply at 20,000 volts is obtained. This high-pressure three-phase supply is carried by underground cables to distributing centres in the city, where the pressure is reduced by the use of sets of three single-phase transformers to 6500 volts to feed the main cables. This supply is converted into direct current, which is distributed on the three-wire system with 250 volts between each outer cable and the neutral or 500 volts across the two outer cables.

Underground cables are armoured with steel wire, and housed in wooden cases filled in with bitumen or drawn through earthenware pipes. Overhead wires are used in many places for the transmission of electrical power. They are less expensive to install than underground cables, and have also the advantage that additional circuits can be connected at very little cost. The overhead wires are usually supported on built-up steel lattice poles, tubular poles such as are used for electric tramway purposes, or wooden poles in pairs with cross-bracings. Porcelain insulators are most commonly used to support the cable lines, but glazed earthenware and glass are sometimes employed. The insulators are large and formed with petticoats and hoods to make leakage only possible over a path of considerable length. The magnitude of the electrical pressure available at any point in the system depends upon the nearness to the station. The drop in electrical pressure is due to the resistance of the cables. Subject to their capability of carrying the greatest currents required without injury,

the cables should have cross-sections which are determined from purely economic considerations. Lord Kelvin discovered the relationship between the cost of a cable and the electrical losses which its use entails. This he enunciated in what is now known as Kelvin's Law, which states: "The economical cross-sectional area of a cable is that for which the annual cost of energy lost just equals the annual interest on the capital invested". At this point of equality the sum of the two charges becomes a minimum.

Electricity is sometimes transmitted on the constant-current system, as, for example, the Thury system in use by the Metropolitan Supply Company. For this type of transmission a number of series-wound generators are connected in series to supply a number of loads also connected in series, the loads being usually motors to drive generators in the sub-stations. Advantages such as the use of high pressure, freedom from induction, capacity, and other problems incidental to alternating-current systems, and the possibility of connecting up heterogeneous generating systems, may lead to considerable extension of its use, particularly in area linking-up schemes.

The transmission of power from the prime movers used on ships to the propellers provides the designer with a series of interesting problems with a series of possible solutions. It is necessary to keep the speed of running of the propellers down to some low value if economical running and efficiency are required, while for the same conditions the power plant (for example, turbines) may require to be run at very high speeds. The methods in use are the introduction of mechanical gearing of the double helical type due to Sir Charles A. Parsons (which is described under the heading *Gearing*), Föttinger hydraulic transformer, or electric propulsion. The hydraulic transformer consists of two parts, first, two centrifugal pump wheels keyed to the turbine shaft, which supply water under pressure to the second part, namely reaction water-turbines on the propeller shaft. Electricity generated by turbine-driven dynamos or alternators is used to operate electric motors on the propeller shafts. This method is used on some of the American battleships.

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Poynings' Law, or the statute of Drogheda, an Act of the Irish Parliament, passed in 1495, whereby all general statutes before that time made in England were declared of force in Ireland. Another article of Poynings' Law secured an initiative of legislation to the English

Privy Council, the Irish Parliament having simply a power of acceptance or rejection of proposed legislation. It was so named from Sir Edward Poynings, Deputy of Ireland under Henry VII in 1494, when he suppressed the revolt of Perkin Warbeck.

Poynter, Sir Edward John, British painter, born in Paris 1836, died in 1919. Educated at Westminster School and Ipswich, he received his art training at the Royal Academy and under Gleyre in Paris; gained a reputation by *Israel in Egypt* (1867) and *The Catapult* (1868); A.R.A. in 1869, R.A. in 1876, president of the Royal Academy and knighted in 1896, created a baronet in 1902. He was Slade professor of art in University College, London, from 1871 to 1875, and director of the National Gallery from 1894 to 1905. Among his chief pictures are: *Perseus and Andromeda*, *Atalanta's Race*, *The Fortune-teller*, *A Visit to Æsculapius, Helen of Troy*, *The Ides of March*, *The Meeting of Solomon and the Queen of Sheba*, *The Ionian Dance*, and *The Cave of the Storm Nymphs*. He is author of *Ten Lectures on Art* (1879).

Pozzuoli (ancient Puteoli), a city and seaport of Southern Italy, in the province of Naples, and on the shore of the Bay of Baïæ (Golfo di Pozzuoli), the north-western portion of the Bay of Naples.¹ Considerable trade and an active fishing are carried on. Pozzuoli is a city of great historic interest. It was founded by the Greeks about 520 B.C., and became under Rome a great centre of commerce. St. Paul landed there in the course of his journey to Rome (cf. *Acts*, xxviii, 13). Pozzuoli was destroyed by the Goths more than once, rebuilt by the Byzantine Greeks, and finally devastated by earthquakes and volcanic eruptions. It abounds in ancient ruins. The cathedral stands on the site of a temple of Augustus, and in one of the lateral walls six Corinthian columns of the old temple are preserved. A ruined temple of Serapis also remains, enclosed by forty-eight marble and granite columns. On an eminence behind the town stands the ruined amphitheatre, resting on three series of arches, where St. Januarius was cast to the lions and where Nero presided over gladiatorial combats. In the neighbourhood are Lake Avernus, the Grotto of the Sibyl, the baths of Nero, the ruins of Baïæ and Cumæ, &c. Pop. 23,000.

Practical Chemistry, that branch of chemistry which deals with the experimental part of the science. Practical chemistry without a knowledge of theoretical chemistry is of little value, and vice versa. Until theoretical chemistry had been established on a firm basis the experimental work undertaken was usually carried out more for gain than for advancement of know-

¹ Ancient *Sinus Puteolanus*.

ledge. The alchemists performed many experiments, but these were all directed towards one aim, namely, the transformation of cheap material into valuable substances.

Practical chemistry of to-day is an exact science, and as physical and chemical instruments become more and more accurate so practical chemistry becomes more precise. When qualitative work was established, balances were crude and therefore work inaccurate. An example of this is the table of atomic weights of the elements. This has been revised many times, owing to experimental determinations becoming more accurate. Practical chemistry may be divided into *analytical chemistry* and *preparative chemistry*. The former deals with the composition of substances, and the proportion of the elements present in compound or mixture; the latter deals with the preparation of elements, compounds, or mixtures of known composition.

To Berzelius is due the greatest advance in inorganic analytical chemistry. He taught the use of small quantities of material, and the modern methods of filtration. From the analysis of a substance much is to be learned. Firstly, it can be determined whether the substance is made up of a single element or of more than one element; secondly, the proportions by weight or by volume of the elements in a compound may be ascertained; and thirdly, the purity of the element or compound may be determined. Analysis of a substance may be carried out in a variety of ways. Valuable information may be obtained by *blow-pipe analysis*, in which the substance is oxidized in the dry state and identified by the characteristic film of oxide; or it may be reduced on charcoal and the metallic bead examined; or it may be made to form a glass by heating with borax, and the glass bead may be identified by its colour and behaviour on oxidation or reduction. Blow-pipe analysis is used in examining certain minerals and metallic oxides. For complete analysis a wet method is employed. The compound or mixture is transformed into soluble chlorides, sulphates, or nitrates by treatment with acids or by fusion with sodium carbonate, and the solution so obtained is examined by means of chemical reagents. Inorganic compounds in solution are ionized, and the solutions give certain tests. Thus a sample of copper pyrites (CuFeS_2) is practically insoluble in water, but if treated with nitric acid, the copper present is transformed into copper nitrate, the iron into iron nitrate, and the sulphur to sulphuric acid. These compounds in solution can then be separated and examined. The actual elements are not separated, but are obtained as compounds of the element.

Besides identifying the elements present in a compound, it is necessary to determine the proportion of the elements in a given amount of the substance. *Qualitative analysis* serves to identify a known substance, but a *quantitative* determination is necessary before analysis is complete. Quantitative analysis may be carried out by *gravimetric methods*, that is, a weighed quantity of substance is dissolved, and the metallic and acidic radicles estimated by transforming into some insoluble compound and weighing the precipitates obtained. Very accurate methods are in use for this. The substance analysed is reported either as pure or impure, or the percentage composition is worked out. *Volumetric analysis* is much employed, as by using standard solutions of reagents accurate determination of one or all elements in a solution may be obtained with only an initial weighing. As the name implies, in this analysis definite volumes of solution are taken, and from these may be calculated the composition of the compound. Volumetric methods are used wherever possible in all analytical laboratories, as the methods are quick and very accurate.

In organic chemistry different methods are used, because organic compounds do not give the usual tests for the elements. For instance, hydrochloric acid (HCl) may be identified by forming the insoluble silver chloride (AgCl) on the addition of an aqueous solution of silver nitrate. On the other hand, chloroform (CHCl_3), an organic compound containing chlorine, does not give a precipitate of silver chloride on addition of a solution of silver nitrate. Organic substances are treated with oxidizing agents, and the presence of carbon in the compound is proved by transforming it into carbon dioxide and identifying that. If the percentage of carbon is required, then a weighed quantity is oxidized by means of cupric oxide, and the carbon dioxide so formed collected and weighed. Hydrogen in the compound is also oxidized to water, and this again is collected and weighed. Chlorine, if present, is first transformed to hydrochloric acid or sodium chloride, and then estimated by volumetric or gravimetric means. Sulphur is oxidized to sulphuric acid, and nitrogen in organic compounds is liberated either as nitrogen or as ammonia by oxidation.

Practical chemistry deals with all preparations of elements, compounds, or mixtures. Synthetic methods may be worked out theoretically, but until these have been proved possible by actual building up of the substance they are of no value. The term *applied chemistry* is sometimes used in connection with the manufacture of chemicals, which is preparative and analytical chemistry applied on the large scale. Small-scale experiments are first of all undertaken, and

if these prove successful, then the method may be employed on the large scale. The fact that a good yield of substance is obtained by an experiment in the laboratory does not necessarily mean a successful yield on the manufacturing scale. Many alterations may have to be made in the process before it is adapted to manufacture. Cost and the time taken in the process are important factors in industry. All these are dealt with by the works chemist. For the examination of drugs and food-stuffs, and for the testing of manufacturing materials in the numerous cases where a certain standard of purity is required, chemical analysis is the indispensable instrument.—BIBLIOGRAPHY: F. Clowes and J. B. Coleman, *Elementary Practical Chemistry and Qualitative Analysis*; W. G. Valentin, *Practical Chemistry*; J. J. Sudborough and T. C. James, *Practical Organic Chemistry*.

Praed, Winthrop Mackworth, English poet, was born in 1802, and died in 1839. His father was an eminent sergeant-at-law. He was educated at Eton, where he founded two magazines, the *Apis Matina* and the *Etonian*, the latter of which had a brilliant career of ten months, an unusually long life for a school magazine. Praed went up to Trinity College, Cambridge, in 1821, and distinguished himself in classics. He was third in the classical tripos in 1825, and won four Browne medals, the Chancellor's medal for English verse twice, and the Scatonian prize. He was elected a Fellow of Trinity in 1827, and embarked on a political career, after having been called to the Bar at the Middle Temple. He entered Parliament in 1830, and in 1834 was appointed secretary to the Board of Control. His health began to break down in 1838, and he died in the year following of a rapid consumption. In spite of his brief and busy life, Praed managed to write a large quantity of beautifully polished society verse. He also wrote some more serious but less effective poems. His classical training helped him to finish his work carefully; some of his light verses are unequalled even by those of Calverley for sparkle and wit. Thus he speaks of a Utopia where there were

poets who deserved the bays,
And did not dread the duns;

and says of his friends:

Some lie beneath the churchyard stone,
And some—before the Speaker.

Indeed, his epigrams and his antitheses are so brilliant and so frequent that after a time they become almost cloying. There is a certain lack of variety in his work, but 'the neat, inevitable turns of Praed' are nevertheless some of the best things in English light verse.

Præfect (*præfectus*), the title of various functionaries of ancient Rome. Of these the

most important was the *præfectus urbi* or *urbis* (præfect of the city). During the kingly period and the early Republic the *præfectus urbis* had the right to exercise all the powers of the king or consuls in their absence. After the foundation of the pratorship this office lost its dignity and privileges; but under the Empire it was revived as that of chief permanent magistrate of the city, with important military functions. The *præfectus pratorio*, an officer under the Empire, was general of the imperial life-guards. His position was one of great power, for the troops under his command frequently decided the succession to the imperial throne. Many other Roman functionaries bore the title of præfect, such as the *præfectus aquarum*, who had charge of the water-supply of the city; the *præfectus ærarii*, who managed the public treasury, &c.

Præmunire, in English law, a name given to offences of the nature of a contempt against the king (or queen) and the Government, or encroachments on the power of the sovereign. The term is derived from the opening words of the writ preparatory to the prosecution of the offence—*præmonere* or *præmunire facias* A. B. (Cause A. B. to be forewarned that he appear before us, &c.). The first statute of *præmunire* was passed during the reign of Edward I to repress the Papal encroachments on the rights of the Crown, and several subsequent statutes before the Reformation greatly extended the number of penal acts under this title. The punishment is forfeiture and imprisonment during the sovereign's pleasure. Many of the statutes are now repealed, and prosecutions upon *præmunire* are unheard of in our times; the last took place during the reign of Charles II.

Prætor, the title of an important official in the ancient Roman state. Up to 367 B.C. the title was merely an adjunct to that of consul; but when at that date the consulship was thrown open to the plebeians, the judicial functions of the consul were separated from his other duties and given to a new patrician magistrate, who was entitled the prætor. In 337, after a struggle, the plebeians were also admitted to this office. In 246 B.C. another magistracy, that of *prætor peregrinus*, was instituted for the purpose of settling disputes between foreigners and between foreigners and citizens; and in distinction from him who filled this office the other functionary was termed *prætor urbānus*. After election the two prætors determined their offices by lot. The *prætor urbānus* was the first in position, and was the chief magistrate for the administration of justice. To the edicts of the successive prætors the Roman law is said to owe in a great measure its development and improvement. About 227 B.C. the number of prætors was increased to four; afterwards to six and eight; and under

the Empire the number varied from twelve to eighteen. After completing his year of office the prætor was often sent as *proprætor* to govern a province.

Prætorian Guard, the body-guard of the Roman emperors, first established as a standing body by Augustus. In the time of the Republic the *cohors prætoria* consisted of troops selected to guard the person of the commander while on active service. Under Augustus only a small detachment of the guard was stationed in Rome, the rest being in the adjacent towns. Tiberius assembled the whole at Rome, and placed them in a permanent fortified camp, where they were



Soldiers of the Prætorian Guard, from a relief in the Louvre, Paris

used to quell any sudden popular disturbance. The number of cohorts was raised by Vitellius from nine to sixteen, and they received double pay; under the later emperors the prætorian guard became powerful enough to decide the succession to the throne, which they once even put up to auction. They were reorganized and their powers curtailed by Septimius Severus and by Diocletian, and were finally disbanded by Constantine the Great in A.D. 312.

Pragmatic Sanction. The general meaning of this term is a rule or Constitution made by a sovereign personally, and relating to the royal prerogative or to the succession to the throne. It is derived from a term of Roman law meaning a decision of the emperor or of the State on some subject of public importance, and the phrase is unknown to English history, but was employed in France, Germany, and Spain. In 1438 Charles VII of France defined the limits of the Papal jurisdiction within his dominions

by a Pragmatic Sanction. The most famous instance of a Pragmatic Sanction is the arrangement made by the Emperor Charles VI for the succession to the Habsburg dominions in the first part of the eighteenth century. The division of the Spanish possessions after the death of Charles II led him to issue in 1713 a Pragmatic Sanction declaring the indivisibility of the Habsburg inheritance. He had married in 1708, but his son, born in 1716, died as an infant, and he devoted the last twenty years of his life to attempting to secure the succession of his daughter Maria Theresa, born in 1717. Acting on the Pragmatic Sanction, he declared her the heiress of the whole of his dominions, to the exclusion of her cousin, the wife of the Elector of Bavaria, afterwards the Emperor Charles VII. This lady was a daughter of the Emperor Joseph I, the elder brother and predecessor of Charles VI, and though the Elector agreed to accept the Pragmatic Sanction and the succession of Maria Theresa, he did so with secret protests and reservations. Other Powers, which had also agreed to the Pragmatic Sanction, were similarly prepared to recede from their undertakings, and the great soldier Prince Eugène warned Charles VI that a large army would be the only real sanction for his daughter's succession. Charles made no such preparation, and on his death in 1740 the Elector of Bavaria asserted his wife's claim to the Habsburg dominions and joined the Powers who brought about the War of the Austrian Succession.—Cf. J. F. Bright, *Maria Theresa*.

Pragmatism is a philosophical theory which insists on usefulness and practical consequences as a test of truth. It maintains that all thought and all cognitive processes are influenced and coloured by the feelings, emotions, or personal bias of the individual concerned; that there is no such thing as pure thought, that thought is always bound up with purpose and practical consideration, that truth has to be tested by its practical consequences, and that we cannot assume that what we call truth is independent of ourselves. Proteus-like, however, pragmatism assumes among its adherents many meanings and different definitions. The reason lies perhaps in the fact that pragmatism is a critical method rather than a doctrine. W. James defined pragmatism as the doctrine "that the whole meaning of a conception expresses itself in practical consequences—consequences either in the shape of conduct to be recommended, or in that of experience to be expected, if the conception be true". In other words, philosophy and knowledge in general are considered in their direct relation to life, action, and human conduct, utilizing it for the requirements of life. Philosophy and thought are to be judged by their

consequences to humanity, but are not an end in themselves.—Concepts are fashioned by the human mind for the manipulation of experience, the preservation, evolution, and advancement of life. According to pragmatism, logical thinking becomes subordinate to practical life, whilst the test of truth is not found in reason but in the practical consequences. Of two concepts, that which 'works well' is true. The term pragmatism was first used by the mathematician C. S. Peirce in 1878, but it is only a new name for an old way of thinking, as the doctrine has existed under different names ever since man began to philosophize. Traces of pragmatism exist in Indian philosophy, and Protagoras expressed pragmatic tendencies when he taught that "man is the measure of all things". Among modern philosophers, Bacon and Hobbes, Pascal and Comte, Fichte and Marx may be said to have held pragmatic ideas. Nietzsche's views are partly pragmatic, whilst Bergson, the opponent of intellectualism, is considered as one of the most logical teachers of pragmatism. Ostwald, Mach, and Avenarius are pragmatists. Pragmatism has, however, been most clearly elaborated by W. James, John Dewey, and F. C. S. Schiller, the last of these calling the doctrine *humanism*.—BIBLIOGRAPHY: W. James, *The Meaning of Truth*; J. B. Pratt, *What is Pragmatism?*; D. L. Murray, *Pragmatism*; F. C. S. Schiller, *Studies in Humanism*; R. B. Perry, *Present Philosophical Tendencies*.

Prague (Czech, *Praha*; Ger. *Prag*), capital of the Republic of Czecho-Slovakia, in Bohemia, on the Vltava, a tributary of the Elbe. The site, a basin enclosed by hills of considerable height, gives to the city a picturesque and striking appearance. The river at this point contains several islands and is spanned by ten bridges, including two railway bridges. Prague is the centre of the Bohemian railway system. The most notable of the bridges is the Karlsbrücke, dating back to the fourteenth century, and reconstructed in 1892 after being much damaged by a flood. The city is famous for its architectural beauty. Hradsehn contains the royal castle, dating in its present form from the fourteenth to the eighteenth century. Beside it is the cathedral of St. Vitus, begun by Charles IV in 1344, and occupying the site of a building erected by St. Wenceslas in 934. The church of St. George is a large Romanesque building largely restored but dating originally from 916. The Teinkirche, in the Altstadt, once the church of the Hussites, contains the grave of Tycho Brahe. Among other notable buildings are the town hall, dating from 1381; the Pulverturm (1475-84); and the Carolinum, containing the university archives and the law classrooms. In the Neustadt are the Bohemian national theatre,

the Bohemian national museum, the medical faculties of the university, the Bohemian technical high school and various educational institutions. The university was founded by Charles IV in 1348, and in 1882-3 it was divided into two, one German and one Czech or Bohemian. The Altstadt is the commercial centre of the town, and carries on a considerable trade by rail and river. The manufacturing quarters are chiefly Bubna, Smichow, and Karolinenthal, the chief products being beer, flour, iron, machinery, wagons, cotton yarn, leather, gloves, chemicals, and railway plant. Pop. 677,000.

History.—Prague is an ancient town, and early became a place of some importance. It owed much to the Emperor Charles IV in the fourteenth century, who laid out the Neustadt, restored the castle, founded the cathedral, and brought the university into existence. During the Hussite struggle the town suffered severely, and in the course of the Thirty Years' War it was several times taken. In 1741 it fell into the hands of the French and Bavarians, and in 1744 it capitulated to Frederick the Great. Near Prague, Frederick in 1757 defeated the Austrians under Prince Charles of Lorraine. The Emperor Joseph II in 1784 united the different sections of Prague into one municipality. The holding of a Slav Congress within it in 1848 led to an Austrian bombardment. It was occupied by the Prussians in 1866, during the war against Austria, and here, on 23rd Aug., was concluded the peace which ended the war. At the outbreak of the European War Prague was the headquarters of the 8th Austro-Hungarian Army Corps. On the break-up of the Empire and the secession of the Czechs and Slovenes it became the capital of Czecho-Slovakia.

Prairie (Lat. *pratium*, meadow; Late Lat. *prataria*), the name given in North America to the vast natural meadows or plains of the Mississippi Valley, especially those lying between it and the Rocky Mountains, and extending into Canada. Throughout this immense territory the differences of level are sufficient to produce a steady flow of the rivers, but not so great as to obstruct their navigation, thus securing a unique system of easy intercommunication between all sections of the country. There is a great sameness in the features of the topography, the vegetable productions, the soil, and geological features. Some of the prairies that have a peculiarly undulating surface are known as *rolling prairies*. Vast herds of buffaloes used to roam over the prairies, but these have now disappeared, and immense tracts are settled for the production of cereals and, near the Rockies, for the raising of cattle.

Prairie-chicken, or **Prairie-hen**, the popular name of the pinnated grouse of the United States

(*Tympanuchus americanus*). The neck of the male is furnished with neck-tufts of eighteen feathers, and is remarkable also for two loose, pendulous, wrinkled skins, which somewhat resemble an orange on inflation. The prairie-hen is much prized for the table. The name prairie-chicken is also given to the sharp-tailed grouse (*Pediæetes phasianellus*), a species of grouse widely distributed in Canada and the north of the United States.

Prairie-dog, or **Prairie Marmot**, a small rodent animal, the wistowish (*Cynomys ludovicianus*), allied to the marmot as well as to the squirrel, and found on the North American prairies west of the Mississippi and east of the Rocky Mountains. These animals live gregariously in burrows, and are characterized by a sharp bark, like that of a small dog, whence their popular name. They are about 1 foot in length exclusive of the tail, which is rather short. Their burrows are quite close together, and have a mound of excavated earth near the entrance, on which the little animals are wont to sit and look around them. These communities are termed 'villages'. A second species, *C. columbianus*, inhabits the region west of the Rockies. A third and larger form, *C. mexicanus*, is found in Mexico. The prairie-dog is not to be confounded with the prairie-squirrel, to which it is allied.

Prairie-squirrel, or **Gopher**, a name for several North American rodent mammals, of the genus *Spermophilus*, found in the prairies in great numbers. They live in burrows, and not on trees, and much resemble the prairie-dog or marmot. They have cheek-pouches, in which their food is carried. This consists of prairie plants with their roots and seeds. See *Souslik*.

Prairie-wolf, or **Coyote** (*Canis latrans*), the small wolf which is found on the prairies in North America. It is a cowardly animal, and only dangerous to man when in packs and pressed by hunger.

Prākṛit (in Skt. *prākṛita*, primitive, vulgar, from *prakṛiti*, nature: as opposed to *samskṛita*, that which is prepared by art, hence the Sanskrit or polished speech: see *Sanskrit*) is a general term used by Hindu grammarians to denote the various vernaculars derived from Sanskrit. This definition would be more correct if we said that Prākṛit denotes the vernaculars derived from the ancient Aryan dialects of India, upon some of which classical Sanskrit is based.

The ancient Prākṛit dialects were those forms of the Aryan speech most commonly used by the masses. The earliest show five groups—the *Sauraseni*, spoken in Sarasena, the modern district around Masura; the *Magadhi*, the ver-

nacular of Bihar; the *Maharashtri*, spoken round Ujjayani or Avanti, in Malwa, perhaps including Southern Rājputāna and the modern northern Marathi country; the *Paisachi*, of uncertain locality; the *Apabhramsa*, or corrupted dialect of Sind and Western Rājputāna. In the Hindu dramas, which are the chief sources of knowledge of early Prākṛits, kings and Brahmins speak Sanskrit, but retainers and people of meaner position speak in different Prākṛits. Pāli is a form of primary Prākṛit, and indeed the five Prākṛits cited may be regarded as the ultimate source of all the modern dialects of India.

Prato, a walled city of Tuscany, North Italy, on the Bisenzio. The cathedral, begun in the twelfth century, and completed in the fourteenth by Giovanni Pisano, contains fine specimens of the work of Fra Filippo Lippi and other masters. Prato has manufactures of straw-plait, bread, and biscuits, besides the spinning of cotton and wool. At Figline near by there are quarries of serpentine, much used by Tuscan builders. Pop. 50,000.

Prawn (*Palæmon*), a genus of crustaceans, ord. Decapoda, section Macrura ('long-tailed'). The common prawn (*Palæmon serratus*) is the most familiar species, and resembles the shrimp. It attains an average length of from 3 to 5 inches. The tail is broad and flat, and its terminal plates are fringed with long hairs. The colour is light-grey spotted with purple. The Isle of Wight and Hampshire coasts form the chief sources of prawn supply to the London market.

Praxiteles, the most celebrated Greek sculptor of the later Attic school, flourished about the middle of the fourth century B.C. His work is marked by grace and delicacy of execution, and, in contrast to that of Pheidias, emphasizes the human and individual character of his subjects. This is well seen in his *Aphrodite of Cnidos*, whom he was the first to represent as a naked figure, in which the woman predominates over the goddess. A statue of Hermēs by him, discovered at Olympia in 1877, is one of the best-preserved examples of Greek sculpture surviving. The so-called *Capitoline Faun*, of which a fine copy exists, was one of his most famous works. The well-known *Niobe and her Children*, at Florence, is sometimes given to Praxiteles, sometimes to Scopas, his contemporary. Praxiteles exercised great influence, and helped to pave the way to the over-elaborate workmanship and exaggerated emotion of Hellenistic sculpture.

Prayer, the expression of a desire or a petition addressed to some force or power conceived as supernatural. Nothing proclaims more consistently and universally the connection between

man and God than the fact that in every time and place men have felt their dependence on a higher Being, and have sought His assistance in prayer. Even the heathen believe that there is some one who can supply their needs. The Scriptures tacitly assume that prayer was offered to God from the beginning of the world; and although we read that "men began to call upon the name of the Lord" after Seth was born, we are forbidden by all commentators to connect this statement with the origin of prayer. It is not, however, until the time of Abraham that prayer comes first distinctly into notice. As the altar appears to have been the special place for prayer in the patriarchal age, so was the tabernacle under the Mosaic covenant until the temple, 'the house of prayer', was built. From the time of the dedication of Solomon's temple the Jews appear to have gone there to pray, and to have turned their faces towards it if they were prevented from going there; and this custom prevails among the Jews at the present time, as does the similar custom among the Mahomedans (q.v.), who turn their faces towards the sacred Kaaba at Mecca. When we come to New Testament times we meet with synagogues established as places for the public worship of God, and for reading His word. Christ taught that prayer should be offered to God in His name in order to ensure an answer. Henceforward Christ became to the Christian what the temple was to the Jew. The posture of the body in prayer is left undecided in Scripture, and although Christ gave His disciples a form of prayer of the most universal application, it does not follow that men may not pray according as each experiences special wants.

Prayer for the dead is a practice rejected by Protestants as having no scriptural warrant, but prevalent in the Roman Catholic, Greek, and other Eastern Churches. The custom seems to have existed in most ancient religions. The doctrine and practice came to the Christian Church through the Jews (2 Macc. xii, 40, 45). The first of the Christian Fathers who mentions prayer for the dead is Tertullian; but he speaks of the usage as long-established in the Church; such prayers are frequently alluded to by St. John Chrysostom, Cyril of Jerusalem, and St. Augustine. In the burial-service of the first *Book of Common Prayer* of the English Church some prayers for the dead appeared, but they were deleted from the second book, and are not found in the subsequent revisions. — BIBLIOGRAPHY: J. Hastings (editor), *Christian Doctrine of Prayer*; E. Bickersteth, *A Treatise on Prayer*; L. R. Farnell, *The Evolution of Religion*; J. Wordsworth, *Holy Communion*; L. Duchesne, *Christian Worship*.

Praying - wheel, an apparatus used among

the Buddhists, consisting of a wheel to which a paper with a written prayer is attached. Each revolution of the wheel made by the devotee counts as an utterance of the prayer.



Tibetan Lamas with Prayer Wheels. Large Prayer Wheels in Background

So also a wheel driven by water-power keeps praying for its owner.

Pre-Adamites, those supposed inhabitants of the earth prior to the creation of Adam. Ancient legends or traditions of the East speak of nations and empires existing before Adam's creation, and of a line of kings who ruled over them. In modern times the subject was taken up by Isaac de la Peyrère, or Pererius (1594-1676), who, in a work published in 1655, maintained that the Jews were the descendants of Adam, and the Gentiles those of a long anterior creation, founding his opinions on *Rom. v, 12-14*. One of the most ancient and widespread myths describes the complete destruction of mankind, which necessitated a new act of creation to repopulate the earth. Hence the belief arose that the present race of men was preceded by another race.

Prebend, a yearly stipend paid from the funds of an ecclesiastical establishment, as of a cathedral or collegiate church. *Prebendary* is the person who has a prebend. A *simple* prebend is restricted to revenue only; a *dignitary* prebend is one which has a jurisdiction annexed.

Pre-cambrian. See *Proterozoic*.

Precedence, the order in which men and women follow each other, according to rank or dignity, in a State procession or on other public

occasions. In England the order of precedence depends partly on statutes, and partly on ancient usage and established custom. Questions arising on matters of precedence depending on usage are hardly considered as definitely settled, and are in a great measure left to the discretion of the officers of arms. The Sovereign, of course, is always first in order of precedence, after whom in descending order follow the Prince of Wales, sons, grandsons, brothers, and uncles of the Sovereign, the Sovereign's brothers' or sisters' sons, the Archbishop of Canterbury, the Lord High Chancellor, the Archbishop of York, Prime Minister, and so on through the high State dignitaries, the various ranks of the peerage, &c. The order of precedence among women follows the same rules as that among men. By the Acts of Union of Scotland and Ireland the precedence in any given degree of the peerage has been established as follows: (1) Peers of England; (2) Peers of Scotland; (3) Peers of Great Britain; (4) Peers of Ireland; (5) Peers of the United Kingdom and Peers of Ireland created subsequent to the Union.

Precedent, in law, a judicial decision which serves as a rule for future determinations in similar cases. Precedents, strictly speaking, are binding on tribunals only when they are actual decisions of the point in question; what is termed an extrajudicial opinion or *obiter dictum*—the opinion of a judge pronounced where it was not called for to decide the issue—can have authority only from the character of the judge, and not as a precedent. Precedents are now of as much authority in courts of equity as in those of common law.

Precentor, an important official in a chapter, whether cathedral or collegiate, who led the singing. He began the verse, whilst the people joined with him at the close, a method which was often varied in the same service with antiphonic or alternate psalmody. The precentor ranked generally, although not universally, next to the dean; but in modern cathedral foundations he is usually a minor canon, and in consequence has lost much of his prestige. He is still, however, everywhere the conductor of the choral service and superintendent of the choir.

Preceptors, College of, founded in 1846 and incorporated by royal charter in 1849, has for its object the examination both of teachers and of pupils. In the teachers' examinations especial stress is laid on the theory and practice of education. Diplomas are awarded, and are of three grades, Fellow, Licentiate, and Associate (F.C.P., L.C.P., and A.C.P.). Periodical examinations are held for pupils, and certificates granted. The college also appoints visiting examiners for schools, and provides courses of lectures for teachers. The head-quarters of the

College of Preceptors is in Bloomsbury Square, London.

Preceptory, in mediæval history, a religious house of the Knights Templars, subordinate to the temple or principal house of the order in London. It was under the government of one of the more eminent knights appointed by the grand-master and called the 'preceptor'.

Precession of the Equinoxes, a slow motion of the line of intersection of the celestial equator or equinoctial and the ecliptic, which causes the positions occupied by the sun at the equinox (the equinoctial points, q.v.) to move backward or westward at the mean rate of 50.26 seconds per year. This motion of the equinox along the ecliptic carries it, with reference to the diurnal motion, continually in advance upon the stars; the place of the equinox among the stars thus precedes at any moment that which it previously held, hence the name. This sweeping round in the heavens of the equinoctial line indicates a motion of the axis of rotation of the earth, such that it describes circles round the poles of the ecliptic in 25,791 years. Nutation (Lat. *nutatio*, a nodding) is a similar but much smaller gyratory motion of the earth's axis, whose period is about nineteen years. From these two causes in combination the axis follows a sinuous path, instead of a circle, about the pole of the ecliptic. Nutation (q.v.) causes the equinoctial points to be alternately in advance of and behind their mean place due to precession by 6.87 seconds. At present the vernal equinoctial point is in the zodiacal constellation Pisces, and it is moving towards the constellation Aquarius.

Precipitate, in chemistry, the name given to the solid particles thrown out of solution when two substances interact in a common medium. Thus, if an aqueous solution of sodium chloride is mixed with an aqueous solution of silver nitrate, double decomposition occurs and silver chloride is immediately formed, and as it is insoluble in water, it is *precipitated* in fine particles.

Precipitate Ointment is the name given to two mercurial ointments, red and white. *White precipitate* is ammoniated mercury (NH_4HgCl); *red precipitate* is the red oxide of mercury.

Precognition, in Scots law, the examination of a witness at some time previous to his appearance in court. Precognitions may be taken in civil or criminal cases by the agents or counsel for any of the parties. In criminal trials the precognitions for the Crown are generally taken by the Procurator-fiscal, and the signature of the witness is affixed; those acting for the defence may also take precognition from the Crown witnesses.

Predestination, in theology, a term used to denote the decree of God, whereby the elect are

foreordained to salvation. The term also signifies generally God's predetermination of events in the world. The theory of predestination represents God's absolute will as determining the eternal destiny of man, not according to the fore-known character of those whose fate is so determined, but according to God's own choice. The doctrine is the logical result of the ideas that God works by plan in governing the world, and that humanity is so sinful that no one could be saved without the operation of God. The theory has been the occasion of many disputes and controversies in the Church in all ages. On the one side, it has been observed that predestination destroys moral distinction, introduces fatalism, and renders all our efforts useless. On the other side, it is contended that if God's knowledge is infinite, He must have known everything from eternity; and that the permission of evil under such circumstances is indistinguishable from a plan or decree under which it is foreordained. The first great champions of these opposite views were Pelagius and Augustine. The former held that there was a possibility of good in man's nature, and that the choice of salvation lay in man's will. Augustine maintained that apart from divine graces there is no possibility of good in human nature, and that since the fall man's will has no power of choice. The system of Augustine was adopted in 529 by the Council of Arausio as the rule of orthodoxy in the Western Church, and forms one of the peculiar characteristics of the Calvinistic theology. The question is left an open one by the Anglican Church, and also by the Roman Catholic Church since the Reformation.—BIBLIOGRAPHY: W. A. Copinger, *A Treatise on Predestination, Election, and Grace*; J. R. Illingworth, *The Divine Immanence*; O. Pfleiderer, *The Philosophy of Religion on the Basis of its History*.

Predicables, in logic, are terms affirmable, as predicates, of other terms. The predicables are said to be five: genus, species, difference, property, and accident. The first two name the higher and lower classes of the things classified; a genus includes more than one species. The other three express the attributes on which the classification is founded.

Pre-emption (Lat. *præ*, before; *emere*, to buy), in law, is the right to the first offer of a thing which is to be sold. Thus in the Articles of Association of private companies it is not infrequently provided that a shareholder who desires to sell or transfer his shares must first offer them to the remaining shareholders or to the directors at a specified price. Again, the former owner of land which has been acquired compulsorily by an authority under the Lands Clauses Acts has a right of pre-emption in respect of any portions not required by the authority;

while in feu charters of land in Scotland it is sometimes agreed that if the feuar wishes to sell he must first offer the subjects to the superior at the price offered by any third party desirous of purchasing.

Pre-existence, Doctrine of, the doctrine that the soul of every man has an existence previous to that of his body. This opinion was very prevalent in the East, and was held by several Greek philosophers, more especially by the Pythagoreans and Empedocles. The belief was also apparently held by Plato, unless we are to consider the views stated by him to be an allegory, rather than a sober statement of belief. A similar doctrine has found some countenance in Christian times as an explanation of the union of soul and body. It was believed that all souls were created before the world, and that each had its proper body allotted to it at the time of birth. In favour of this theory appeal is made to these peculiar sensations which are sometimes raised by sights or sounds, which we feel conscious of having had a former familiarity with, though reason would persuade us we had seen them for the first time. The doctrine is supported by some modern writers, and is the basal idea of Wordsworth's *Ode on the Intimations of Immortality from Recollections of Early Childhood*.

Préfet (prâ-fâ; Lat. *præfectus*), the title of an important political functionary in France. Previous to the reign of Henri II the officers who were sent round to the provinces to superintend the details of administration on behalf of the sovereign were called *maîtres des requêtes*. In 1551 Henri II established them as perpetual overseers in all provinces, and under Louis XIII (1635) they received the name of *intendants*. The offices were abolished by the National Convention, but were restored by Napoleon by the law of 17th Feb., 1800, and the functionaries received the appellation of *préfets*. There is a préfet at the head of each department, who is entrusted with the whole organization and management of the police establishments; but not with the punishment of police offences. Within this sphere of action the préfets are unchecked; the sous-préfets, who are appointed by them, and who stand at the head of the districts, are entirely subject to their commands; and the authorities of the communes, as well as the justices of the peace, can set no limits to their activity. In time of tumult they can call out the military, or provisionally declare a state of siege. The Council of the Préfecture is a court in which are settled all disputes respecting the taxation of individuals, engagements with the State for building, the indemnification of those who have had to give up anything to the public, &c. Of this court the préfet is president, and in it he

has a casting-vote. The appeals against its decisions lie to the Council of State.

Pregnancy is the state of a woman who is with child. It lasts from 273 to 280 days, taking the time from conception to the birth of the child. Among the earliest signs of pregnancy are the cessation of menstruation, and sickness, usually most marked in the early part of the day, and thus known as 'morning sickness'. This sickness may be slight and only a few weeks in duration, or it may be more severe and last for three or four months, causing considerable discomfort, while in some cases it persists from its onset to the termination of the pregnancy. Changes in the breasts are seen during the second and third months, and in the fourth month slight enlargement of the abdomen is evident, and this enlargement continues progressively throughout pregnancy. About the sixteenth or seventeenth week the mother becomes aware of the movements of the child, at first very slight, but later more marked, and this is known as quickening. The first wholly conclusive evidence of pregnancy is detection of the sounds of the child's heart, heard by applying a stethoscope to the lower part of the abdomen of the mother. The child's heart beats at about double the rate of the maternal heart, and can be heard from the eighteenth week onward.

During pregnancy women should pay special attention to digestion and take regular exercise, while they should avoid any undue exertions or excitements and not wear any tight clothing. Many of the minor troubles and afflictions of pregnancy can be overcome or prevented by the mother seeking skilled advice, and of late years much has been done in this way by antenatal clinics, and by the spread of knowledge of physiological conditions among the public.

Pregnancy, Concealment of, in Scots law, was originally made a crime in 1690 by statute, and punishable with death, as described in Sir Walter Scott's novel *The Heart of Midlothian*. In 1809 the punishment was modified to two years' imprisonment. The concealment must be interpreted very strictly; communication of the fact of pregnancy to any one at any time, even by clear inference only, is sufficient to rebut the accusation. It must be proved that the woman failed to call for or make use of assistance in the birth, and that the child is dead or amissing. In indictments for child-murder concealment of pregnancy is usually inserted as an alternative charge. The crime is not known to the law of England.

Prel'ate, in Church law, one of those spiritual dignitaries who exercise jurisdiction in their own name. These were originally only the bishops,

archbishops, patriarchs, and the Pope. The cardinals and legates, abbots and priors, also obtained certain privileges of jurisdiction by grant or prescription. The term is now commonly used merely to signify one of the higher dignitaries of the Church.

Pre'lude, in music, originally the first part of a sonata; though, as the name implies, it may be an introduction to any piece of music. Bach and his contemporaries elaborated preludes considerably; and Chopin wrote several piano works which, though complete in themselves, he designated preludes. The term has been also applied to operatic introductions when they are shorter than the usual overture. Wagner in particular has prefaced most of his operas with a prelude. From the time of writing *Lohengrin* he used the word prelude instead of overture.

Premier (Fr. *premier*; Lat. *primus*, first), an abbreviated form of Prime or Premier Minister; the first minister of a state. In the British Empire the first ministers of autonomous or semi-autonomous states, colonies, and dominions also receive this appellation, and, as in the Imperial Government, derive their appointment by recognized hegemony in the predominant political party of the state. The British Premier's official residence is at No. 10 Downing Street, Whitehall, London, the Chancellor of the Exchequer occupying No. 11, and the offices of the Government Whips No. 12. His country residence is Chequers (q.v.). He has no salary as Prime Minister, but he usually holds the premiership in connection with the first lordship of the treasury, the chancellorship of the exchequer, a secretaryship of state, or the privy seal. George I could neither speak nor understand English, and it was under his reign that a Prime Minister was appointed to direct affairs of State in the king's absence, or ignorance. The office, however, was not officially recognized until 1905. A table of the various Premiers since 1806 will be found on the following page.

Premonstratensians, or **Norbertines**, a religious order founded at Prémontré, near Laon in France, by St. Norbert in 1120, who gave them the rule of St. Augustine with some additional rigour. The order was introduced into England in 1146, and its members were there regularly known as the White Canons. Before the Reformation they had 2000 monasteries, among which were 500 nunneries, mostly in Germany, the Netherlands, France, England, and the north of Europe; but the Reformation diminished this number by more than one-half in the sixteenth century. Since the end of the seventeenth century the order declined in numbers, but there was a revival in the nineteenth century, and there are houses in Holland and Austria, and some in England.

Premier.	Appointed.	Political Party.
Grenville	Feb., 1806	—
Portland	March, 1807	—
S. Perceval	Dec., 1809	—
Liverpool	June, 1812	—
Canning	April, 1827	—
Goderich	Sept., 1827	—
Wellington	Jan., 1828	—
Grey	Nov., 1830	—
Melbourne	July, 1834	—
Sir R. Peel	Dec., 1834	—
Melbourne	April, 1835	—
Sir R. Peel	Sept., 1841	—
Lord J. Russell	July, 1846	Liberal
Derby	Feb., 1852	Conservative
Aberdeen	Dec., 1852	Coalition
Palmerston	Feb., 1855	Liberal
Derby	Feb., 1858	Conservative
Palmerston	June, 1859	Liberal
Russell	Nov., 1865	Liberal
Derby	July, 1866	Conservative
H. Disraeli	Feb., 1868	Conservative
W. E. Gladstone	Dec., 1868	Liberal
H. Disraeli (Beaconsfield)	Feb., 1874	Conservative
W. E. Gladstone	April, 1880	Liberal
Salisbury	June, 1885	Conservative
W. E. Gladstone	Feb., 1886	Liberal
Salisbury	Aug., 1886	Conservative
W. E. Gladstone	Aug., 1892	Liberal
Rosebery	March, 1894	Liberal
Salisbury	July, 1895	Conservative
A. J. Balfour	July, 1902	Conservative
Sir H. Campbell-Bannerman	Dec., 1905	Liberal
H. H. Asquith	April, 1908	Liberal
H. H. Asquith	May, 1915	Coalition
D. Lloyd George	Dec., 1916	Coalition
D. Lloyd George	Jan., 1919	Coalition
A. Bonar Law	Oct., 1922	Conservative

Prenzlau (prents'lou), a town of Prussia, in the province of Brandenburg, on the Ucker. It became a town in 1235, and was incorporated in Brandenburg in 1480. Pop. 21,000.

Pre-Raphaelite Brotherhood, the name adopted in 1848 by a group of seven young artists, Dante Gabriel Rossetti, Holman Hunt, J. E. Millais, J. Collinson, F. G. Stephens, painters; Thomas Woolner, sculptor; and W. M. Rossetti, writer. The name of the society was an expression of their belief that up to the time of Raphael artists had worked by the light of nature and of truth, but that afterwards mannerism and imitation had been the rule. The aims of the brotherhood, as stated by D. G. Rossetti, were: "(1) To have genuine ideas to express; (2) to study Nature attentively so as to know how to express them; (3) to sympathize with what is direct and serious and heartfelt in previous art, to the exclusion of what is conventional and self-parading and learned by rote; and (4) most indispensable of all, to produce thoroughly good pictures and statues". Rossetti, Hunt, and Millais were the most important members. The work of Rossetti, poet as well as painter, is full of mystic symbolism and passion, though technically inadequate in drawing and colour. His most notable paintings are: *Ecce Ancilla Domini* (National Gallery), a triptych in Llan-

daff Cathedral, *Beata Beatrix*, *Monna Vanna*, and *Dante's Dream*. In contrast to the temperament of Rossetti are the more solid qualities of Holman Hunt, whose painstaking art, with its exaggerated attention to detail, lacks inspiration notwithstanding its sincerity. Typical works are: *The Light of the World*, *Isabella and the Pot of Basil*, and the *Triumph of the Innocents* (National Gallery). Of the three, technically the most accomplished was Millais, whose precocious talent won him a medal at the Royal Academy schools at the age of thirteen, and made him a successful painter before he was twenty. Until 1859 he was faithful to Pre-Raphaelite ideas; but his *Vale of Rest*, painted in that year, marks the beginning of the popular and commonplace art of his later years, which brought him a baronetcy and the presidency of the Royal Academy. His Pre-Raphaelite work includes: *Lorenzo in the House of Isabella*, *The Carpenter's Shop* (Tate Gallery), *Ophelia* (National Gallery), *The Huguenot*, and *Sir Isumbras at the Ford*.

Although the original group did not long continue as a society, its teachings, which found a powerful advocate in Ruskin, spread far and exerted great influence on British art. Among the painters who more or less completely adopted its principles are: A. Hughes, R. B. Martineau, Frederick Sandys, W. H. Deverell, Charles Collins, Noel Paton, Burne-Jones, and J. F. Lewis. Ford Madox Brown, who had been Rossetti's master, was never a member of the brotherhood; but his later paintings, such as *Work* (Manchester Art Gallery), show its influence strongly.—**BIBLIOGRAPHY:** Percy Bate, *English Pre-Raphaelite Painters*; Holman Hunt, *The Pre-Raphaelite Brotherhood*; Ruskin, *Notes on Royal Academy Exhibitions*.

Presbyopia is 'old-sightedness', and is due to failure of accommodation of the lens of the eye on account of age. Its effect is to cause objects near the eye to be less distinct than those at some distance, and it therefore affects reading. It is corrected by the use of convex glasses worn only for reading.

Presbyter (Gr. *presbyteros*, an elder), an office-bearer in the early Christian Church, the exact character and position of whom is differently regarded by different authorities. Presbyterians generally maintain that originally *bishop* and *presbyter* were one and the same; Episcopalians generally maintain that from the first they were different, as was certainly the case in very early times. By the end of the second century the presbyters held a position in connection with the congregations intermediate between that of bishop and deacon, and represented the priests or second order of clergy.

Presbyterianism is one of the three great

divisions of ecclesiastical polity. Independency or congregationalism regards the local congregation as autonomous. Prelacy or episcopalianism rests upon a diocesan episcopate, with a gradation of rank and office, and a distinction between the clergy and the laity. Presbyterianism means that the ministers are all on one footing, that the Church is governed by presbyters or elders, and that there is a gradation of church courts which conserves unity. There is no distinction between clergy and laity in presbyterianism; laymen are presbyters, but ruling presbyters, while ministers are ordained to teach or preach and administer the sacraments, but in the church courts there is absolute parity. These courts are the kirk-session, the presbytery, and the General Assembly. In some Churches there are synods, between the presbytery and the General Assembly, and congregational boards of managers or deacons, whose task is to supervise the finances and look after the fabric of the local church. But the presbytery is the characteristic court, composed of ministers and elders from each congregation in the district. Its decisions may be reviewed, on appeal, by the General Assembly, composed of members from the various presbyteries selected in a certain proportion. The General Assembly's decision is final. The kirk-session of the local congregation, of which the minister is head, supervises the spiritual affairs of the church, and its decisions may be taken to the presbytery and even to the General Assembly. The minister, though called by the local congregation, is ordained by the presbytery, without whose consent no step of this kind can be taken. He is responsible to the presbytery, and can only be deposed by the General Assembly. Kirk-sessions and presbyteries usually meet once a month, the General Assembly once a year.

It is claimed that the principle of Presbyterianism is recognized in the primitive Church where the Apostles chose presbyters or elders to superintend the churches. These constituted a presbytery (1 Tim. iv, 14). Eventually, out of these presbyters, who were called 'overseers' or bishops, one came to assume a permanent position, which developed into the monarchical episcopate. At the Reformation many of the Churches reverted to what they considered the original and authoritative organization of presbyterianism, and this was thought out by Calvin at Geneva, whose administrative genius moulded presbyterianism for the future. Local varieties exist, but, under all modifications, the essential principles already noted persist. Originally presbyterianism was characterized by (a) Calvinistic doctrine, (b) a recognition of national religion, (c) a puritanic worship, and (d) popular government. The last-named has been least

altered; the idea, congenial to democracy, is that the whole body ought to legislate for itself, functioning through chosen members. In earlier days a *ius divinum* was sought for this, as for episcopacy. Such an argument is no longer tenable. Church polity belongs to the well-being rather than to the being of the Church. Presbyterianism justifies itself by its efficiency, as it answers the ends which are regarded as vital to the Church of God in the mind and purpose of Christ. When it is held that the ministerial office is not sacerdotal, and also that the Church is more than a collection of separate particles, presbyterianism comes forward with the historical and practical claim to furnish a valid ministry and a truly Catholic Church.

The latest statistics assign over 6½ millions to presbyterianism, on the Continent, in Great Britain, Canada and America, and elsewhere.—BIBLIOGRAPHY: J. Macpherson, *Presbyterianism* (1883); A. Wright, *The Presbyterian Church* (1895); J. N. Ogilvie, *The Presbyterian Churches* (1896); R. C. Reed, *History of the Presbyterian Churches of the World* (1905); W. M. Macphail, *The Presbyterian Church* (1908). The early apostolic period is discussed in books like A. V. G. Allen's *Christian Institutions* (1898) and T. M. Lindsay's *Church and Ministry in the Early Centuries* (1902).

Pres'bytery, a judicatory, consisting of the pastors of all the churches of any particular Presbyterian denomination within a given district, along with their ruling (i.e. presiding) elders, there being one ruling elder from each church-session commissioned to represent the congregation in conjunction with the minister. The functions of the presbytery are: to grant licences to preach the gospel, and to judge of the qualifications of such as apply for them; to ordain ministers to vacant charges; to judge in cases of reference for advice, and in complaints and appeals which come from the church-sessions within the bounds of the presbytery; and generally to superintend whatever relates to the spiritual interests of the several congregations under its charge, both in respect of doctrine and discipline. Appeals may be taken from the presbytery to the provincial synod, and thence to the General Assembly.

Prescott, William Hickling, American historian, born in Salem, Massachusetts, 1796, died 1859. The son of a judge and grandson of Colonel William Prescott, he was educated at Harvard College, where he graduated in 1814. Acquaintance with Spanish literature, which he began to cultivate in 1824, led him to attempt his first work on Spanish history, *The Reign of Ferdinand and Isabella*, published 1837. His next works were *The History of the Conquest of Mexico, with a Preliminary View of the Ancient*

Mexican Civilization, and *The Life of the Conqueror Hernando Cortez*, which appeared in 1843. In 1847 he published *The History of the Conquest of Peru, with a Preliminary View of the Civilization of the Incas*. In 1855 the first two volumes of his *History of the Reign of Philip II, King of Spain*, appeared. His collected works in 20 vols. appeared in 1906.

Prescription, in law, is a right or title acquired by use and time; the object being to secure the title to property to him who has had the possession of it for the term fixed by the law, and to prevent anyone from disturbing his possession after such term has expired. In the English common law the term *prescription* is applied only to incorporeal hereditaments, as a right of way, a common, &c., and requires immemorial time to establish it. This rule was modified, however, by the passing of the statute 2 and 3 William IV cap. lxxi, which provides that no right of common shall be defeated after thirty years' enjoyment, and after sixty years the right is deemed absolute and indefeasible, unless had by consent or agreement. In claims of right of way, of water-course, and similar easements, the periods are twenty and forty years. Claims to the use of light to any dwelling-house or building enjoyed for twenty years are indefeasible, unless shown to have been by consent.

By the law of Scotland prescription has a much wider operation than by the law of England. It may be the means of acquiring a right (positive prescription) or of extinguishing an obligation (negative prescription). It thus not only protects individuals from actions which other parties might have brought against them, but in some instances creates a positive title to property. Until the Conveyancing Act, 1874, was passed, the prescription by which a right of property could be established was that of forty years. By the last-mentioned statute, however, the period of prescription is reduced to twenty years. The party holding the property must have been twenty years in unchallenged possession, and be able to show an *ex facie* valid irredeemable title recorded in the appropriate Register of Sasines. For the acquisition of any servitude, right of way, &c., forty years' use is still essential. The period of the long negative prescription is also forty years. The other and shorter prescriptions are as follows: The vicennial, applicable to holograph writings not attested with the usual formalities; the decennial, applicable to actions against tutors and curators; the septennial, applicable to actions against cautioners; the sexennial, applicable to bills of exchange or promissory notes; the quinquennial, applicable to verbal contracts concerning moveables, and arrears of rent in an

agricultural lease; the triennial or three years' prescription, applicable to claims for ordinary accounts, servants' wages, &c. The general effect of these short prescriptions is not to extinguish the obligation but to change the onus, and limit the mode, of proof. By Scots law also, but not by English, a vicennial prescription (it is supposed) applies to crimes, no prosecution being competent after a period of twenty years.

Prescription, in medicine, denotes the document given by a medical practitioner to his patient in order that he may obtain the medicaments prescribed for the relief or cure of the malady from which he suffers. Prescriptions have been given from the earliest times, and had a religious character, the blessings of the gods being invoked upon each. Every prescription to-day begins with such an invocation, written as *R*, but as a matter of fact this symbol is now held to represent the first letter of the Latin word *recipe*, take thou, the imperative mood of the verb *recipere*, to take. Until quite recent times prescriptions were written in full or abbreviated Latin, but now medical students are taught to write their prescriptions thus: names of medicaments in full Latin (abbreviated somewhat in actual practice), quantities in symbols, and directions in English. The writing of a prescription is an art which can only be acquired by experience and study, for the physician, after deciding which remedy or remedies he will use in a particular case, has to consider the question of incompatibility in its threefold aspect—therapeutical, chemical, and physical. The fact that so many proprietary medicines are prescribed by qualified practitioners is evidence of the difficulties encountered by some and the method by which they are avoided. Most prescriptions when carefully analysed exhibit a fourfold character, viz. (1) the ingredient which is the 'basis' of the prescription and upon which the efficiency of the preparation depends; (2) one or more ingredients which improve the action of the basis, the 'adjuvans'; (3) one or more ingredients which correct the actions of (1) and (2), the 'corrigens'; and (4) the ingredients which impart an agreeable form, the 'constituens' vehicle or excipient. Many prescribers prefer to order as far as possible a single remedy in their prescriptions, a practice which has many advantages. The homœopathic practitioners carry the idea of single remedies to its legitimate conclusion, and only prescribe one medicament at a time, two being a violation of their principles.

Prescriptions are usually regarded as the property of the patient who has received them, and are returned to him by the pharmacist

when they have been copied and dispensed. Copies of prescriptions are frequently demanded for various reasons, but the pharmacist grants copies of his copy as an act of grace, and considers himself to be acting within his rights when he refuses copies to all applicants except the owner of the original prescription. The idea of ownership has been disturbed by the provisions of the Dangerous Drugs Act, 1920, under which the pharmacist is directed to retain original prescriptions which contain the various poisons dealt with under this Act; in this case the practitioner is affected too, for he must give his own name, address, and qualifications, as well as the name and address of the patient. Under the National Insurance Acts all prescriptions are the property of the Commissioners.

Presentation, the nomination of one or several candidates to a vacant office; commonly used in the case of a patron to a church. In England the clergyman is presented to the bishop to be instituted in a benefice; in Scotland, before the abolition of church patronage, he was presented to the presbytery for induction.

Presentment, in law, is, properly speaking, the notice taken by a grand-jury of any offence, from their own knowledge or observation, or any representation made by the jury to the court—arising, it may be, out of their deliberations.

Preserved Foods, kept from corruption by comparatively simple means, have certainly been known and used from very early times. Fresh meat and fish were either merely dried in the sun or by artificial heat, were rubbed with salt or steeped in brine, or smoked. The nutritive properties of milk were, and still are, largely preserved in the forms of butter and cheese; while wine is the preserved juice of the grape. All housewives have for centuries been well acquainted with entirely successful ways of preserving fruit as jam, in syrup, or by drying; while various vegetables have long been pickled in vinegar. But the use of salt, sugar, or vinegar effects material changes in the nature of the food. Modern science has discovered methods of preserving some important foods in their original condition, and, by the same process, prepares them for immediate consumption. The decay and consequent speedy corruption of food materials is caused by the attacks of organisms, either animal or vegetable. Food preserved from these, in which all the living organisms are destroyed, can, in theory, be kept wholesome for an indefinite period, or, for practical purposes, for many months or even years.

It was a Frenchman, François Appert (died 1840), who, early in the last century, first advocated the method now generally in use,

paving the way to food preservation on a wholesale scale. Advances on his system have been made, but the essentials are the same. Meat, packed in round or oblong tins, is cooked in heated chambers, the tins first being closed, although a pin-hole aperture for the escape of air may be left, and sealed up on the completion of the process, which combines cooking with sterilization. Soldering has long been the usual method of closing the tins, but of late years hermetic sealing—fusion of the edges of the metal—has come into use.

The acids of some kinds of food materials having an effect on tin, various methods of treating the inner surface of the cases have been tried, including coating with a special varnish. In cases where the sterilizing process has not been effectively performed, gases are usually, though not invariably, generated by the subsequent decomposition; the tin bulges from the pressure of the gas, thus giving automatic warning of the danger of its contents. Germs calculated to produce ptomaine poisoning may, however, be present in the absence of this sign; and the fear resulting from occasional cases of illness or death traceable to preserved food, coupled with the great 'Chicago scandals' of some years ago, has brought about a certain prejudice against tinned foods. Some manufacturers have avoided this drawback by cooking and sterilizing the meat in the usual tins, and then transferring it to receptacles of glass or earthenware. Ptomaine poisoning is, however, exceedingly rare in proportion to the enormous quantities of tinned foods now consumed, and the danger may be regarded as almost, if not entirely, negligible.

The occurrence of *B. Botulinus* (see *Botulism*) in tinned foods is rare, but this germ or its toxin has been found in sausages and hams on the Continent, and in vegetables, beans, and cheese in America. As a consequence of the Loch Maree case, in which, on 14th Aug., 1922, six guests and two ghillies from the Loch Maree Hotel lost their lives by consuming potted-meat sandwiches affected with spores and the deadly toxin of *B. Botulinus*, arrangements were made by the Ministry of Health for a supply of an antitoxin to be held at certain centres in England, and to be available immediately on demand. These centres are Plymouth, Cardiff, Birmingham, Manchester, and Newcastle; the Board of Health for Scotland has a similar arrangement of centres.

Among meats, beef and brawn, largely packed in the United States and in South America, are most in use; mutton, both chilled and tinned, reaches Britain in large quantities from Australia and New Zealand; while tongues and a great variety of 'fancy' potted meats command a ready sale. Tinned salmon, largely from the

Fraser and Columbia Rivers of the great 'North-West', herrings and lobsters, with sardines in oil from France, are the chief items among fish. The tomato is a leading fruit for treatment; while pineapples and apricots are brought within the reach of purchasers for whom such luxuries were formerly a name and little more. Condensed milk, first experimented with in 1835, is now produced in vast quantities, largely in Switzerland, but also in Canada, Holland, and the United States. The process employed is that of evaporation, usually with the addition of sugar.

The science of modern food preserving has, among other benefits, enabled the explorer in any region to carry with him a varied and nutritive larder; has lessened on the sailing-ship the prevalence of scurvy, formerly so frequent among crews deprived of fresh vegetables; and has provided the poorer classes of the community with food ready for consumption, almost invariably wholesome, and moderate in price. Appert's *L'art de conserver toutes les substances animales et végétales* (1831) is of interest for the early history of the modern science.

Pres'ident, signifying he who presides, has several special and technical senses. It is used for (1) the principal member of a society or association, who takes the chair when present at meetings; (2) the chief official of a company or board; (3) the head of a university or college, or of a learned faculty; (4) the elected chief of a republic. In England, the Lord President of the Council, the chief of the Privy Council, is an officer of State whose duty is to act as a sort of intermediary between the sovereign and the council. In Scotland, the Lord President of the Court of Session is the presiding judge in the supreme court.

Press, Freedom of the, the liberty of every citizen to print whatever he chooses, and his immunity from responsibility to the Government. This liberty, however, does not prevent his being amenable to justice should he abuse his privilege. The right of printing rests on the same abstract grounds as the right of speech, and it might seem strange to a man unacquainted with history that printing should be subjected to a previous censorship, as it is in some states, and has been in all, any more than speaking, and that the liberty of the press should be expressly provided for in the Constitutions of most free states. But when we look to history we find the origin of this, as of many other legislative anomalies, in periods when politics, religion, and individual rights were confusedly intermingled. It is only since men's views of the just limits of government have become clearer that the liberty of the press has been recognized as a right; and to England we are

particularly indebted for the establishment of this principle. The existence of a censorship of the press was for centuries, however, deemed an essential to the safety of all European governments. Liberty of printing, as we understand it, is a comparatively modern notion; Milton's plea for a free press met with no response from his own party, nor for very many years later was it the cue of any party in the English commonwealth to refrain from suppressing the writings of their political opponents. In England the liberty of the press, soon after printing was introduced, was regulated by the king's proclamations, prohibitions, charters of licence, &c., and finally by the Court of Star-Chamber. The Long Parliament, after their rupture with Charles I, assumed the same power. The Government of Charles II imitated their ordinances, and the press did not really become free till the expiration of the statutes restricting it in 1693, after which it was found impossible to pass new laws in restraint of it, and it has remained free ever since, the last restriction being done away with on the abolition of the newspaper stamp duty in 1856. Such legal checks as remain are merely intended to prevent outrages on religion or decency, to protect subjects from defamation, and to conserve the copyright of authors. Almost complete liberty of the press now prevails in England in peace-time. In war-time, however, as was witnessed during the European War, a rigid censorship is imposed. The Constitutions of many of the United States declare, as we should expect, for liberty of the press. The same may be said of all the South American republics. Among European countries, it may be generally said the liberty of the press is found most predominant in Spain, Portugal, Sweden and Norway, Switzerland, and Roumania; in France the press may be said to be comparatively free; while in Germany and Austria there are still many restrictions, and in Russia at present (1922) only one paper, *Pravda* (The Truth, an obvious misnomer), is permitted by Lenin to exist. In the British colonies the law is as in England, but in India the Governor-General exercises a censorship.

Pressburg (Bratislava), a city of Czechoslovakia, formerly in Hungary, on the Danube, and on the southern spurs of the Little Carpathians. The ruined royal palace, on the top of an eminence, was burned in 1811. The cathedral (St. Martin), a large Gothic structure, was begun in 1090 and completed in 1472, and here the Kings of Hungary were crowned. The Franciscan church, founded in 1290, is also noteworthy. There is a Slovene university, founded in 1912. The river is crossed by a bridge of boats. The manufactures are various. The

trade, particularly transit, and chiefly in corn and timber, is extensive.

Pressburg is a place of very great antiquity, and was long a fortress of some strength. In 1541, when the Turks captured Buda, it became the capital of Hungary, and retained the honour till the Emperor Joseph II restored it to Buda. The Hungaria name for the town is Pozsony. The treaty by which Austria ceded Venice to France and the Tyrol to Bavaria was signed here in 1805. Pressburg was incorporated in Czecho-Slovakia after the European War (1914-18). Pop. 78,000.

Press-gang, a detachment of seamen who, under a naval officer, were empowered to lay hold of seafaring men and compel them to serve in the king's ships. Although originally designed to serve the needs of the army as well as the navy, the system of impressment (q.v.) became confined to the navy, and, despite the fact that it has long fallen into abeyance, it is still legally permissible, for the laws enforcing impressment have never been repealed. The mode of procedure was crude, and the quality of the recruits obtained was seldom equal to that evinced by the poorest volunteer. When recruits were required, a body of men was detailed from the ship's company of a man-of-war. They were armed to the teeth, and went ashore under the command of one or more officers, searching all the known haunts of seafaring people and forcibly carrying them off. As it was not in their nature to surrender quietly, the impressed men usually fought as for their very lives, and the 'takers', as they were called in Elizabethan days, being unpopular in all seaport towns, frequently had to fight women as well as men to make good their captures. All seamen between the ages of eighteen and fifty-five years were eligible for impressment, excepting apprentices of under two years' service, fishermen at sea, a suitable proportion of seamen manning colliers, and harpooners in whalers. In cases of national emergency landmen were eligible for 'taking', and a merchantman or privateer might be boarded at sea. The most suitable recruits for a hazardous naval life were undoubtedly those obtained from privateers, and such vessels usually gave friendly warships of whatever type a very wide berth. By 1835 the term of compulsory service had been limited from a life-time to five years, and thereafter the system died a natural death. The press-gang, with all its petty brutalities and violent strife, is dealt with in the novels of Marryat and Smollett.

Prester John (Priest, or Presbyter John), a supposed Christian king and priest. In the Middle Ages it was reported by travellers that there was a Christian prince who reigned in the

interior of Asia under this name. The first record of Prester John appears in the chronicle of Otto of Freisingen in the twelfth century. The legend then grew and developed. Rubruck, in the thirteenth century, attributes the name of Prester John to a Nestorian prince, Ung or Ungh Khan, who perished in a war against Genghis Khan. Who this Prester John was it is not easy to decide; the supposition that he was the Dalai Lama, or one of the chief priests of the Lamaites, does not agree with the position assigned to his residence by travellers. The Portuguese, in the fifteenth century, picked up a story of a Christian prince in Central Africa, and by some confusion of names they transferred thither the throne of Prester John. Hence in recent times the home of this mythical prince and priest has always been laid in Abyssinia. Prester John is described in the *Travels* of Sir John Mandeville, is mentioned by Marlowe (*Tamburlaine the Great*) as Prester John of Africa, and is referred to by Shakespeare in *Much Ado About Nothing*. In Ariosto's *Orlando Furioso* he is the blind king of Ethiopia.—**BIBLIOGRAPHY:** S. Baring-Gould, *Curious Myths of the Middle Ages*; G. Brunet, *La Légende du prêtre Jean*.

Preston, a municipal and county borough and seaport of Lancashire, England, on the Ribble near the head of the estuary; served by the London & North-Western and Lancashire & Yorkshire Railways. Among the principal buildings are the parish church, the Roman Catholic church of St. Walpurgis, and the town hall; among other chief buildings are the grammar-school, the free library, and the technical school. The river is spanned by five bridges, two of them railway bridges. The railway station forms one of the most important junctions on the London & North-Western Railway. The original staple manufacture of the town was linen, which is still woven to some extent, but has been completely eclipsed by the cotton manufacture. Preston also has electrical engineering works, numerous machine-shops, iron- and brass-foundries, railway-carriage works, steam sawmills, breweries, malt-houses, roperies, tanneries, &c., and extensive harbour and river works. Ships of about 3000 tons burden can utilize the port with comfort, through a deepening and widening scheme executed in 1884.

The town arose to take the place of the ancient *Coccium* or *Ribchester*, some 12 miles north of the modern town, where there are well-defined Roman remains. It received the name of Priest's Town, corrupted successively into Prestune, Prest-town, and Preston, from the early settlement at it of religious residents. Before the Norman Conquest (1066) it was held by Earl Tostig, and belonged, in the time of Richard I, to

Theobald, brother of Archbishop Hubert. In 1221 a Greyfriary was founded, and a monastic hospital of Mary Magdalene was also established, but no remains of these institutions are now extant. In 1323 it was taken and burned by Robert Bruce; in the great Civil War it espoused the Royalist cause, and was twice captured by the Parliamentarians; Cromwell defeated the Royalists here in 1648. In the rebellion of 1715 it was occupied by the Jacobite forces (under Thomas Foster and the Earl of Derwentwater, &c.), and in that of 1745 the Highlanders, headed by Prince Charles Edward, passed through Preston both on their march to London and on their retreat. Preston was the birthplace of Arkwright and of the notorious Lady Hamilton. The town was chartered by Henry II (1179), received thirteen charters from subsequent kings, and sent two members to Parliament from 1295 to 1331, and from 1529 to 1918. Pop. (1921), 117,426.—Cf. H. Fishwick, *History of the Parish of Preston*.

Prestonpans, a coast town (police burgh) of Haddingtonshire, Scotland, on the Forth; served by the North British Railway. Once noted for its salt industry (whence the 'pans'), it now produces beer, bricks, and tiles, and there is a considerable fishing industry. Coal-mines are located in the vicinity. Within a mile of the town is the battlefield where Prince Charles Edward gained a decisive victory over Sir John Cope (*Hevy, Johnnie Cope*) and the Royalist forces on 21st Sept., 1745. Prestonpans became a burgh in 1617. The salt trade, which is now extinct, originated in 1185-6, and remained a thriving industry until about 1800. Pop. (1921), 2000.

Prestwich, an urban district of Lancashire, England, 4 miles from Manchester; served by the Lancashire & Yorkshire Railway. The chief industry is in cotton. Near by are the reservoirs which supply the city of Manchester with water. Pop. (1921), 18,750.

Prestwick, a town of Scotland, on the coast of Ayrshire, 2½ miles north of Ayr; served by the Glasgow & South-Western Railway; a popular health-resort and the head-quarters of golf in the west of Scotland. Pop. 8500.

Presumption, in law, is the assuming of a fact or proposition as true. The *presumptio juris* is a presumption established in law till the contrary be proved, e.g. the possessor of goods is presumed to be the owner. The *presumptio juris et de jure* is that where law or custom establishes any proposition that cannot be overcome by contrary evidence, as the incapacity in a minor with guardians to act without their consent.

Pretoria, the capital of the Transvaal, and the administrative capital of the Union of South

Africa, on the northern slope of the valley formed by the Apies River, a small tributary of the Crocodile, 4471 feet above sea-level; by railway 46 miles from Johannesburg, 1040 miles from Cape Town, and 349 miles from Delagoa Bay. There are Government buildings, courts of justice, post office, English cathedral and other churches, synagogue, opera-house, market buildings, museum, &c. It came into British possession in June, 1900, as one result of the South African War. Pop. (1921), 73,770 (28,607 being coloured persons).

Prevention of Crimes Act, an Act of Parliament passed in 1908 with a view to providing for the reformation of young offenders and the detention of habitual criminals. When a young person of sixteen to twenty-one years of age is convicted of an offence for which the penalty is penal servitude or imprisonment, and in consequence of his criminal habits or tendencies or his association with persons of bad character it is desirable to do so, the court, instead of imposing such a penalty, may pass sentence of detention under penal discipline in a Borstal institution for a period of one to three years. Every person so detained remains under the supervision of the Prison Commissioners for six months after discharge. Incurables may be committed to prison for the unexpired portion of the period of detention. See *Prisons*.

An habitual criminal is defined as one who since attaining sixteen years of age has been at least three times convicted of a crime and is persistently leading a dishonest or criminal life, or who has on any previous conviction of a crime been found to be an habitual criminal and sentenced to preventive detention. These, in addition to a sentence of penal servitude, may be ordered to be kept in detention on its expiry for a period of five to ten years, if by reason of their criminal habits and mode of life such a course is expedient for the protection of the public.

Prev'esa, a town of Greece, on the northern side of the Gulf of Arta. To the north of the town are the ruins of Nikopolis, founded by Augustus to commemorate the battle of Actium. Pop. 6000.

Prévost d'Exiles (prā-vō deg-zēl), Antoine François, a French writer, born in 1697, died in 1763. Originally a member of the Jesuit order, he soon quitted it for a military career. After alternating several times between the Church and the army he gave up both professions, and in 1729 he went to Holland, where he published his *Mémoires d'un homme de qualité*. After a sojourn of two years in England he returned to France, and was appointed almoner and secretary to the Prince de Conti. From this period till his death he pursued an

active literary life, editing a journal called *Pour et Contre*, and publishing many romances, of which the best known is the famous *Histoire du Chevalier des Grieux et de Manon Lescaut*.

Pri'am, in Greek legend, the last King of Troy, the son of Laomedon. By his second wife, Hecuba, he had, according to Homer, nineteen children, the most famous being Hector, Paris, Cassandra, and Troilus. When he was extremely old, the Greeks demanded of him the restoration of Helen, who had been carried away by Paris, and on his refusal to give her up they made war against Troy, and took and destroyed the city after a siege of ten years. Homer gives no account of the death of Priam; but other poets represent him to have been slain at the altar of Zeus by Pyrrhus the Greek.

Pri'a'pus, a Greek deity, the deformed son of Dionysus and Aphrodite, a god of gardens, fruits, &c., considered by mythologists to represent fertility in nature. He was worshipped in all parts of Greece, though chiefly at the Greek settlement of Lampsacus on the Hellespont, and also in Rome.

Pribram (prshē'brám), a town of Czechoslovakia, in Bohemia, in a district where are rich lead- and silver-mines. Pop. 13,000.

Prib'ylov (or **Pribyloff**) **Islands**, a group of islands on the coast of Alaska, United States, in Behring Sea. The largest are St. Paul, St. George, Walrus, and Beaver Islands. They are frequented by numbers of fur-seals. The natives are Aleutians. The islands were visited in 1786 by Gerasim Pribylov (and named after him), and were acquired by the United States in 1867.

Price, Richard, British political and moral philosopher and divine, born in 1723, died in 1791. He commenced his literary career in 1758 by his *Review of the Principal Questions in Morals*, which was followed by *Four Dissertations on the Importance of Christianity, the Nature of Historical Evidence, and Miracle*. In 1771 appeared his *Observations on Reversionary Payments and Annuities*, and later the celebrated *Northampton Mortality Tables*. He also published a number of political tracts, in one of which he advocated the cause of the American colonies in 1776. When Pitt became Prime Minister, he consulted Dr. Price in his schemes for the reduction of the national debt, and the establishment of the sinking fund was the result of his recommendation. At the commencement of the French Revolution, in a sermon (published in 1789) *On the Love of Country*, he warmly expressed his delight at the emancipation of the French people. This discourse produced Burke's *Reflections*, in which Dr. Price was severely treated.

Prickles, in botany, hard, pointed emergences or outgrowths of the epidermis and subjacent

layers, as in the rose and the bramble. They are to be distinguished from the various forms of *spines* or *thorns*, which are modified leaves or shoots.

Prickly Ash, a name given to several prickly shrubs of the United States, genus *Xanthoxylum*, ord. Rutaceæ. They have an aromatic and pungent bark, which from being used as a remedy for toothache gains them the name of *toothache tree*.

Prickly Heat (*miliaria*) is an acute eruption of papules and vesicles on the skin, and is accompanied by marked itching. It is a common affection in the tropics among white people, while the native population are unaffected. It may also occur in some people after severe exertion or vapour baths. Thick woollen underclothing should not be worn, and if possible only silk. Frequent changes are necessary. Severe exercise, hot drinks, and alcohol should be avoided.

Prickly Pear (*Opuntia vulgaris*), nat. ord. Cactaceæ. The opuntia is a fleshy and succulent plant, destitute of leaves, covered with clusters of spines, and consisting of flattened joints inserted upon each other. The fruit is purplish in colour, covered with fine prickles, and edible. The flower is large and yellow. It is a native of the tropical parts of America, whence it has been introduced into Europe, Mauritius, Arabia, Syria, and China. It is easily propagated, and in some countries is used as a hedge-plant. It attains a height of 7 or 8 feet.



Prickly Pear (*Opuntia Dillenii*)

Priest (Heb. *kôhên*; Gr. *hiercus*; Lat. *sacerdos*; from Gr. *presbyteros*, elder), generally, one whose function is to expound religious doctrines, and to perform on behalf of the community certain public religious acts. Among the ancient pagan nations all that was dignified and venerable, that deserved respect and obedience, that was supposed to stand nearer to the Divinity than the common mass of mortals, was associated with the idea of the priestly office. The patriarch of the primitive world was at once the king and the priest of his family. When the state was developed from the family, the royal and priestly dignity still continued for a long time to be

united in the same person. The offices, however, became separated in those states of antiquity which owed their existence to the ascendancy of single heroes or conquering tribes. By the side of the regal dignity and sovereignty a sacerdotal order grew up, which in some countries was elective, in others hereditary. The priests, also honoured as magicians and physicians, gained a reputation for superior wisdom, and were said to be in secret communion with the gods; their persons inspired the mass of the people with awe. In sacred history the patriarchal order furnishes an example of the family priesthood. Abraham, Isaac, and Jacob perform priestly acts, and "draw near to the Lord", as also does Job, and the Arab sheikh to this hour unites in his person the civil and religious headship. The Mosaic priesthood was the inheritance of the sons of Aaron, of the tribe of Levi. The order of the priests stood between the high-priest on the one hand and the Levites on the other. It is considered by many scholars that the Jewish priesthood was modelled in some measure upon that of Egypt, where the sacerdotal order constituted the highest of the four principal castes into which the people were divided. They were the principal advisers of the king, were endowed with land and exempt from taxes, and besides their religious functions, also discharged the duties of judges and legislators. In the New Testament believers generally are regarded as having the character of priests, and it is held by many Protestants that the idea of a consecrated priesthood invested with sacrificial functions is repugnant to Christianity. In some Churches, therefore, the name priest is not used, minister, pastor, &c., being the term employed instead. Those Christians, however, who, like the Roman Catholics, Greeks, &c., look upon the eucharist as a sacrifice, regard the priest as performing sacrificial duties, and as standing in a special relation between God and his fellow-men. The priests of the Church of Rome are bound to a life of celibacy; but in the Greek Church a married man may be consecrated a priest. In the Anglican and other Episcopal Churches the priests form the second and most numerous order of clergy. Diverse views of the priestly office are held in the Anglican and allied Churches.—BIBLIOGRAPHY: F. B. Jevons, *Introduction to the History of Religion*; W. Sanday, *Different Conceptions of Priesthood and Sacrifice*; H. Evans, *The Price of Priestcraft*.

Priestley, Joseph, English theologian and scientist, chiefly noted as the discoverer of oxygen, was born in Yorkshire in 1733, and died in Pennsylvania in 1804. He had a most original and versatile intellect, and wrote voluminously on theology, philosophy, politics, and science. By profession he was a dissenting

minister, but for some time he acted as classical master in a school, and, at a later date, as librarian and companion to a nobleman. His religious and political views were unorthodox, and made him unpopular. In theology he was a Socinian, and in politics an advanced Radical. His sympathy with the French revolutionists led on one occasion to his house being set on fire by a hostile mob. But his character was beyond reproach, and it is significant that at the very moment when his 'atheism' was causing him to be disliked and avoided in England, his scientific friends in Paris were deriding him for his religious faith. Priestley's chief claim to distinction rests on his scientific work. On the strength of his discoveries in electricity he was elected F.R.S. in 1766. The *History of Electricity* was published in 1767. The law of the inverse square in electrostatics and the oscillatory nature of the discharge of a Leyden jar are two points in which he anticipated the results of later and better-known researches. In 1770 Priestley turned his attention to chemistry, in which he had become interested through watching the processes carried on in a brewery near his house. In 1774, by heating mercuric oxide, he obtained oxygen, which he called *dephlogisticated air* (see *Phlogiston*). He also obtained, in most cases for the first time, the eight gases now known as nitrogen, hydrochloric acid, nitrous oxide, nitric oxide, ammonia, carbonic oxide, sulphur dioxide, and silicon tetrafluoride. He was the first to use the method of collecting gases in a pneumatic trough over mercury. Only his unfortunate prepossession on the subject of phlogiston prevented him from being the father of modern chemistry instead of Lavoisier. His sons emigrated to America in 1793; Priestley followed them a year later, and never returned to England. His works were edited by J. T. Rutt.—BIBLIOGRAPHY: *Dictionary of National Biography*; J. Martineau, *Essays, Reviews, and Addresses*; J. H. Muirhead, *Nine Famous Birmingham Men*.

Prim, Juan, Marquis de los Castillejos, Count de Reuss, Field-marshal and Grandee of Spain, was born at Reuss, in Catalonia, in 1814, and died in 1870. Entering the army at an early age, he rose rapidly, and was appointed colonel in 1837. He vigorously opposed Espartero, who had assumed the regency of Spain on 8th May, 1841, and brought about the latter's downfall. In recognition of his services he was created a count by Queen Christina in 1843. Sentenced to imprisonment on a charge of conspiracy against the life of Narvaez, he was pardoned by the queen and appointed Governor of Porto Rico. Exiled for some time, he lived in France and in England, and afterwards served in the

campaign of Morocco. For his services from 1847 to 1860 he was created a marquis. He afterwards joined Serrano in the Revolution which ended in the downfall of Queen Isabella. Shortly after the election of Amadeo, Duke of Aosta, as King of Spain, Prim was shot by an assassin.

Primage, originally a customary gratuity to the master of a ship, afterwards an extra charge for special care or stowage of freight. It has now been entirely abandoned.

Primary, in geology, a term applied by the early geologists to rocks of a more or less crystalline structure, supposed to owe their present state to igneous agency. They were divided into two groups: *stratified*, consisting of gneiss, mica schist, argillaceous schist, hornblende schist, and all slaty and crystalline strata generally; and *unstratified*, these being chiefly granite. By geologists of a later day the term primary was used as equivalent to *Paleozoic*, the name given to the oldest known group of stratified rocks, extending from the Cambrian to the Permian formation. See *Geology*.

Primate, in the early Christian Church the title assumed by the bishop of the capital of a province, and hence equivalent to metropolitan. In Africa the title belonged to the bishop who had been longest ordained. In France the Archbishop of Lyons was appointed primate of the Gauls by Gregory VII in 1079. In the Church of England both the archbishops still retain the title of primate, the Archbishop of Canterbury being distinguished as the primate of *all* England, and the Archbishop of York as the primate of England. In the Protestant Episcopal Church of Ireland the Archbishop of Armagh is primate of *all* Ireland, and the Archbishop of Dublin primate of Ireland, as formerly when the Church was established. The present Archbishop of Canterbury and primate of all England is the Most Reverend Randall Thomas Davidson, G.C.V.O., who became archbishop in 1903, after being consecrated Bishop of Rochester (1891), and translated to Winchester (1895). The present Archbishop of York and primate of England is the Most Reverend Cosmo Gordon Lang, who became archbishop in 1908, after being consecrated Bishop of Stepney in 1901.

Primates (*-tēs*), the highest order of the Mammalia, including man, monkeys, apes, and lemurs.

Prime, in the Roman Catholic Church one of the canonical hours, and also the service of the breviary which falls to be performed at that time. The term is derived from the Lat. *prima* (that is, *prima hora*, first hour), because prime begins with the first hour of the day according to the Eastern mode of reckoning, namely, six o'clock.

Priming, the carrying of small drops of water by steam. Insufficient steam space and badly designed flues and pipes in the boiler are among the causes of priming. The steam is taken away from a boiler through a collecting pipe situated in the steam space. This pipe has saw-cuts in it, through which the steam passes on its way to the stop-valve. The function of the collecting pipe is to prevent water being carried away with the steam. The main piping is provided with drains through which any water, produced by the condensation of steam, can be passed out. Wet steam is not only objectionable because of the reduced heat-content of each pound, but it has the disadvantage that its presence in the valve-chest of an engine is the cause of an increase in the 'missing quantity'. Water in pipes conveying superheated steam has been the cause of great trouble in steam-engineering research work. The flow is stratified, and, although the readings of a thermometer may show that there is a great amount of superheat in the middle zone, the contact of the colder outside layer with the wall of the pipe is the cause of a certain amount of condensation.

Primogeniture, the right of the eldest son and those who derive through him to succeed to the property of the ancestor. The first-born in the patriarchal ages had among the Jews a superiority over his brethren, but the "insolent prerogative of primogeniture", as Gibbon denominates it, was especially an institution developed under feudalism. Before the Norman Conquest the descent of lands in England was to all the sons alike, but gradually the right of succession by primogeniture came to prevail everywhere, except in Kent, where the ancient gavelkind tenure still remained. The right of primogeniture is entirely abolished in France and Belgium, but it prevails in some degree in most other countries of Europe. By Act of Parliament primogeniture is abolished for deaths after 1st Jan., 1925. The rule operates only in cases of intestacy, and is as follows: When a person dies intestate, leaving real estate, his eldest son is entitled by law to the whole. If the eldest son is dead, but has left an eldest son, the latter succeeds to the whole of the property. If the whole male line is exhausted, then the daughters succeed—not in the same way, however, but jointly, except in the case of the crown, to which the eldest succeeds. In the United States no distinction of age or sex is made in the descent of estates to lineal descendants.—Cf. Sir William Blackstone, *Commentaries on the Laws of England*.

Primrose (*Primula*), the type-genus of the ord. Primulaceæ, with radical leaves, flowers in an umbel, tubular, five-cleft calyx, and salver-shaped corolla with five lobes. The species.

about seventy in number, are perennial and mostly alpine. Many of them are dimorphic, with *thrum-eyed* and *pin-eyed* forms, the former having the stamens at the mouth of the tube, the latter with the stigma showing. (See *Heterostyly*.) There are five British species: *P. vulgaris*, the common primrose of spring, in which the umbellate arrangement of the flowers is disguised by the shortness of the scape; *P. veris*, the cowslip; *P. elatior*, the oxlip; *P. farinosa*, the bird's-eye primrose; and *P. scotica*, the Scottish primrose. The polyanthus is a cultivated variety of the cowslip, and the garden auriculas are derived from an alpine species, *P. auricula*. A favourite cultivated species is the Chinese primrose (*P. sinensis*).

Primrose League, The, took its origin and name in 1883, when Sir H. Drummond Wolff, seeing primroses in the button-holes of Conservative members of Parliament who attended the unveiling of the statue of Lord Beaconsfield, said to Lord Randolph Churchill: "Let us found a primrose league". Some doubt has been thrown on the question of the primrose being the famous Premier's favourite flower; but, in spite of ridicule, the project flourished. Women were soon admitted to its ranks, and the membership, less than one thousand in 1884, amounted to a quarter of a million two years later, and is now nearly three millions. The government and organization is by 'habitations', of which there are about three thousand; members are classed as 'dames', 'knights', and 'associates'; and the badge is the monogram P.L., encircled by a wreath of primroses, the five petals of the flower being an emblem of Anglo-Saxon ascendancy in the continents of Europe, Asia, Africa, America, and Australia. The motto is *Imperium et Libertas*, and the principles inculcated are "the maintenance of religion, of the estates of the realm, and of the imperial ascendancy of Great Britain". The office of Grand Master is now filled by the Marquess Curzon of Kedleston. The 19th of April is Primrose Day.

Primulaceæ, a natural order of gamopetalous dicotyledons, characterized generally by a five-cleft calyx, five-partite corolla, five epipetalous stamens, single style, undivided stigma, one-celled ovary with free-central placentation, capsular fruit, and usually simple radical leaves. The species are herbs, almost confined to the temperate and cold regions of the northern hemisphere. The principal genera are: *Primula* (see *Primrose*), *Lysimachia*, *Anagallis*, *Cyclamen*, and *Soldanella*.

Prince (Lat. *princeps*), literally one who holds the first place. The epithet, originally applied to the *princeps senatus* of the Roman state, subsequently became a title of dignity.

The title was adopted by Augustus and his successors. In modern times the title of prince (or princess) is given to all sovereigns generally, as well as to their sons and daughters and their nearest relations. Until the Revolution of 1918 there was a class of sovereigns in Germany, ruling little states, such as Reuss, and ranking below the dukes. They were called *Fürsten*, whilst the members of the royal family were styled *Prinzen*. On the Continent there are also families not immediately connected with any reigning house who bear the title of prince; such were Bismarck and Metternich.

Prince Edward Island, the smallest and most densely peopled province of the Dominion of Canada, in the Gulf of St. Lawrence, separated by Northumberland Strait from the mainland of Nova Scotia and New Brunswick. The island is of irregular outline, with a deeply indented coast-line dividing it into three well-defined regions. It is low-lying, but the climate is healthy and far milder than that of the contiguous mainland provinces.

Area, &c.—The area of the island is 2184 sq. miles. Pop. (1921), 88,536. The principal cities and their populations (1911) are Charlottetown (the capital), 11,203, and Summerside, 2678.

Religion.—Roman Catholicism is the predominant faith, with 41,994 adherents in 1911. Others are: Presbyterian (27,509), Methodist (12,209), Baptist (5372), and Anglican (4939). Jurisdiction over the Roman Catholics is held by the Bishop of Charlottetown, and over the Anglicans by the Bishop of Nova Scotia.

People.—The people are mainly of British stock, the origins in order of importance being Scots (40,000), English (24,000), Irish (21,000), French (13,000), and all other nationalities about 1000.

Education.—Elementary instruction has been free since 1852, and is theoretically compulsory; but the law is inoperative through the exigencies of an agricultural community and inadequate means of enforcement. There is no university, and no facilities for higher instruction are provided other than in the Roman Catholic college of St. Dunstan's and the Prince of Wales College, both secondary schools and located in Charlottetown.

Communications.—There are (1921) 279 miles of railway. A line runs from Charlottetown to Tignish in the north-west via Summerside. At Emerald Junction there is a branch running southwards to Cape Traverse, a terminal station. There is a terminal station of the Canadian National on the mainland of New Brunswick, directly across Northumberland Strait, at Cape Tormentine. In 1918 a powerful car-ferry steamer began operations, and affords Prince Edward Island a means of daily communication

with the mainland without transshipment. The strait, however, is generally closed by ice from the middle of December to the beginning of April, and a regular service frequently becomes impossible, giving rise to considerable agitation for a railway tunnel between the island and the New Brunswick mainland.

Production: Agriculture.—Prince Edward Island is the garden province of Canada, and the people and the soil are almost entirely devoted to agricultural pursuits. Oats, potatoes, and roots (turnips, mangolds, &c.) are the staple crops, but barley and spring-wheat are also produced. Dairying is progressive, and butter and cheese are extensively made. Poultry-farming is also practised. Beef, bacon, hams, poultry, butter, eggs, cheese, and potatoes are exported. The trade of the island is chiefly inter-provincial, i.e. with the other provinces of the Dominion. **Minerals.**—There are neither minerals nor mines. **Fisheries.**—These are of great value, lobsters (which are canned at Charlottetown), herring, cod, mackerel, and smelts being found. Oysters (Malpeque), for which the fisheries were once famous, are now almost extinct from the ravages of destructive pests, and although in 1912 the provincial authorities acquired control of the adjacent beds from the Dominion Government, extensive planting operations have hitherto been attended with but little success.

History.—Prince Edward Island was first sighted by Cartier in June, 1534. It was colonized by the French (1534-1798), and was known as the Ile Stc. Jean. In 1798 it was renamed out of compliment to the Duke of Kent, then commanding the British forces in North America. Great Britain obtained the island in 1763, when it was administered by the Government of Nova Scotia, but it was eventually erected into a separate colony, the first Parliament meeting in 1773; and the island was admitted to the confederation as a province a century later (1873). Modern government is in the hands of a Lieutenant-Governor, who is assisted by a responsible ministry. The Legislative Assembly, 30 members, elected partly by property-holders and partly by universal male and female suffrage, sits for a period of four years. Women are eligible for election. Four Senators and four members of Parliament represent the province in the Dominion Parliament at Ottawa.

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Prince of Wales, the title of the heir-apparent to the British throne, first conferred by Edward I on his son (afterwards Edward II) at the time of his conquest of the Principality of Wales. Edward III was never Prince of Wales, but the title has been conferred on all the male heirs-apparent to the English (and afterwards the British) throne from Edward the Black Prince, son of Edward III. The heir-apparent is made Prince of Wales and Earl of Chester by special creation and investiture, or by proclamation, but as the king's eldest son he is by inheritance Duke of Cornwall. As heir to the crown of Scotland, the Prince of Wales bears the titles of Prince and High Steward of Scotland, Duke of Rothesay, Earl of Carrick, Baron Renfrew, and Lord of the Isles, in virtue of an Act of the Scottish Parliament of 1469. The title of Earl of Dublin was borne by Edward VII as Prince of Wales. The arms of the Prince of Wales are the royal arms, with the addition of a label of three points argent, and any other addition that may be adopted. The Prince of Wales has also a badge, consisting of a plume of three white ostrich feathers, with the motto *Ich dien* (I serve).

Prince Rupert, a seaport-town of British Columbia, on Kaien Island, at the mouth of the Skeena River; the Pacific terminal of the Grand Trunk Pacific Railway. There is a magnificent natural harbour over 10 miles in length, and the harbourage facilities are extensive. A 20,000-ton floating dry dock belonging to the railway is in active operation. Within five hours' sailing are the richest halibut banks in the world, and salmon, cod, and herring are also caught in enormous quantities. Hematite and magnetite ores are found in the district, as are gold, silver, lead, zinc, molybdenite, and copper. Pop. (1922), 6380.—*Cf. Heaton's Annual*.

Princeton, a borough of the United States, in Mercer county, New Jersey; served by the Pennsylvania Railway, by the Delaware & Raritan Canal, and by electric-traction lines to Trenton, &c. It is the seat of Princeton University, one of the first educational institutions in the country, and also of the theological seminary of the Presbyterians and the Rockefeller Research Institute. Pop. 5600.

Príncipe, a Portuguese West African island, in the Bight of Biafra, midway between São Thomé and Fernando Po. It is mountainous and unhealthy. See *São Thomé and Príncipe*.

Pringlea, a peculiar genus of Cruciferae. The single species, *P. antiscorbutica*, the Kerguelen cabbage, is well adapted for wind-pollination—a rare condition among Crucifers—having no petals, protruding anthers, and long thread-like papillæ on the stigma; the exceptional structure is explained by the lack of winged insects on

Kerguelen Island, where these cannot survive owing to the incessant gales.

Printing, in a general sense, is the art of stamping impressions of figures, letters, or signs, with ink, upon paper, vellum, cloth, or any similar substance; but the term is also applied to the production of photographs from negatives, where neither ink nor pressure is used. Printing may be done (1) from engraved metal plates, in which the ink is stored for transference in the sunk or incised lines of the pattern (see *Engraving*); (2) from a level surface, as polished stone, where the ink is confined to the lines by a repellent medium (see *Lithography*); or (3) from surfaces in relief, where the ink is transferred from the raised characters, which may be either on one block or on separate or movable types. The last-named method is so much the most important that it gives its restricted meaning to the term *printing*, unless where otherwise qualified.

History.—The rudiments of the art of *typography* or *letterpress-printing* were undoubtedly known to the ancients so far as the taking of impressions from blocks is concerned, and this method is still practised in China. The ancient Romans made use of metal stamps, with characters engraved in relief, to mark their articles of trade and commerce; and Cicero, in his work *De Natura Deorum*, has a passage from which Toland imagines the moderns have taken the hint of printing. Cicero orders the types to be made of metal, and calls them *forma literarum*, the very words used by the first printers. In Virgil's time, too, brands with letters were used for marking cattle, &c., with the owner's name.

Block-printing in Europe, from single pieces of wood, can be traced back as far as the twelfth century. In these blocks the lines to be printed were in relief, as in modern wood-engraving, and each leaf of the book was printed from a single block. The leaves were usually printed only on one side of the paper, the blank sides being afterwards pasted together so as to give the volume the ordinary book appearance. By the middle of the fifteenth century block-book making was a distinct craft in Germany and the Netherlands. Among the earliest species of German origin is an *Apocalypse*, containing forty-eight illustrations on as many leaves; and among those of Netherlandish origin, the *Biblia Pauperum* of forty leaves—both works of the early fifteenth century.

It is a matter of much dispute to whom is due the merit of adopting movable types. The invention has long been popularly credited to Johan Gutenberg, but critical examination of early Dutch and German specimens and historical evidence would seem to point to Laurens Janszoon Coster of Haarlem as the first inventor.

(See *Coster*; *Gutenberg*.) The date of the Haarlem invention is variously placed between 1420 and 1430. Coster's types were first of beech wood, then of lead, and lastly of tin; the first book printed from movable types being probably one entitled *Speculum Nostræ Salutis*. Gutenberg in 1449 became associated with a rich citizen in Mainz, named Johann Fust or Faust, who advanced the capital necessary to prosecute the business of printing. Soon after (probably in 1453) Peter Schöffer, who afterwards became Fust's son-in-law, was taken into copartnership, and to him belongs the merit of inventing matrices for casting types, each individual type having hitherto been cut in wood or metal. The oldest work of any considerable size printed in Mainz with cast letters, by Gutenberg, Fust, and Schöffer, finished about 1455, is the Latin Bible, which is called the *Forty-two-lined Bible*, because in every full column it has forty-two lines; or the *Mazarin Bible*, from a copy having been discovered in the library of Cardinal Mazarin in Paris. Fust having separated from Gutenberg in 1456, and obtained the printing-press for his own use, undertook, in connection with Peter Schöffer, greater typographical works, in which the art was carried to higher perfection. Fust was particularly engaged in the printing of the *Latin and German Bible*, the first copies of which, bearing date, were printed in 1462. Fust is said to have died of the plague in 1466 at Paris, upon which Peter Schöffer continued the printing business alone at Mainz. After the separation of Gutenberg and Fust the former had found means to procure a new printing-press, and had printed many works, of which the most remarkable is the *Astrological and Medical Calendar* (in folio, 1457). In 1462 the city of Mainz was taken and sacked by Adolphus, Count of Nassau, and this circumstance is said to have so deranged the establishment of Fust and Schöffer that many of their workmen were obliged to seek employment elsewhere. The truth seems to be that the inventor of the new art was Coster; that Gutenberg and Schöffer made important improvements on it, and aided by Fust widely spread the results of the new art. From this period printing made rapid progress throughout Europe. In 1465 we find works printed at Subiaco by Conrad Sweynheym and Arnold Pannarts, two of the most celebrated among the early printers, who in 1467 removed to Rome. In 1469 we find printing at Venice and Milan; in 1470 at Paris, Nürnberg, and Verona; and by 1472 the art had become known in all the important cities of the Continent. In 1488 it had reached Constantinople, and by the middle of the next century had extended to Russia and America.

At the invention of printing the character of

type employed was the old Gothic or German. The *Roman* type was first used at Strasbourg about 1464, by a printer known as 'the R printer' on account of a peculiarly shaped R, and was introduced into Italy by Sweynheym and Pannarts at Subiaco in 1465 and at Rome in 1467. In England Richard Pynson printed Pace's *Oratio in Pace nuperrima* in this type in 1518. The *Italic* type, said to be an imitation of the handwriting of Petrarch, was first used at Venice by Aldus Manutius in the *Virgil* of 1500. At first, however, the capitals were Roman in form. Designed for the printing of classics, *Italic* type was found useful to differentiate introductions, prefaces, notes, &c., from the text; then for quotations; afterwards for emphasizing certain words, and in the Bible for indicating words not in the original Hebrew or Greek. Schöffer, in his edition of Cicero's *De Officiis*, produces for the first time some Greek characters, rudely executed; but the earliest complete Greek work was a grammar of that language printed at Milan in 1476. The *Pentateuch*, which appeared in 1482, was the first work printed in the Hebrew character, and the earliest known *Polyglot Bible*—Hebrew, Arabic, Chaldaic, Greek, Latin—issued from the press of Genoa in 1516. Several printers' names have become famous not only for the beauty of their types, but also for the general excellence of their productions. Among these may be noted: The Aldi of Venice (1490–1597), Baden of Paris (1495–1535), Estiennes or Stephens of Paris (1502–98), Plantin of Antwerp (1514–89), Wechel of Paris and Frankfort (1530–72), Elzevir of Leyden and Amsterdam (1580–1680), and Bodoni of Parma (1768–1813).

The art of printing was first introduced into England by William Caxton, who established a press in Westminster Abbey in 1476. (See *Caxton*.) His two most distinguished successors were Wynkin de Worde and Richard Pynson. The former, a native of the Dukedom of Lorraine, served under Caxton, and after the death of his master successfully practised the art of printing on his own account. The books which he printed are very numerous, and display a rapid improvement in the typographic art. He died in 1534. Pynson was a native of Normandy, and it is supposed that he also served under Caxton. The works which he printed are neither so numerous nor so beautiful as those of Wynkin de Worde. To Wynkin de Worde and Pynson succeeds a long list of ancient typographers, into which we cannot enter here.

The first Scottish printers of whom we have any authentic account were Walter Chepman, a merchant in Edinburgh, and Andrew Millar, who, in consequence of a patent from James IV, established a press at Edinburgh in 1507. In

1536 Thomas Davidson printed, 'in the Fryere's Winde', Edinburgh, the *Chronicles of Scotland*, by Boethius, and in 1540 the works of Sir David Lindsay. Robert Leprevik printed extensively both at Edinburgh and St. Andrews. Thomas Vautrollier was another old Scottish printer, who brought out, in 1585, Calvin's *Institutes*; in 1580, Tusser's *Points of Good Husbandry*; and in 1597 the *Demonologie* of King James VI. Edward Raban, a native of Gloucestershire or Worcestershire, introduced the art into Aberdeen about 1620–2, and continued printing there till 1649. In 1638 George Anderson, by special invitation of the magistrates, set up the first printing-press in Glasgow. In later days Scotland highly distinguished itself by the extent and beauty of its typographical productions. Ruddiman, who flourished at Edinburgh during the first half of the eighteenth century, was one of the most learned printers which any country has produced. The art has continued to flourish in the Scottish capital, and printing is now one of its chief industries. In Urie, in Robert and Andrew Foulis, in the Duncans, and others, Glasgow has produced printers whose works are alike celebrated for their appearance and accuracy. In 1551 the *Common Prayer* was printed in Dublin by Humfrey Powell, 4to, black letter, and this is the earliest recorded production of the Irish press; but until as far down as 1700 very few books were printed in Ireland. Alderman George Faulkner, who lived in the eighteenth century, may be considered as the father of Irish typography. Printing was introduced in the New England States of America in 1639, the first known print being the *Freeman's Oath*; in 1640 what is known as the *Bay Psalm-book* was printed in Cambridge, Massachusetts.

Processes.—The various letters and marks used in printing are cast on types or rectangular pieces of metal, having the sign in relief on the upper end. These types, with the low pieces required to fill up spaces, are placed in cells or boxes in a shallow tray or case in such a way that any letter can readily be found. The cases are mounted on a stand or frame, so that they may lie before the person who is to select and arrange the types, technically styled a *compositor*. The Roman types used are of three kinds: an alphabet of large capitals (A B C, &c.), one of small capitals (A B C, &c.), and one of small letters (a b c, &c.), called *lower-case* by the compositor. Of italic characters only large capitals and lower-case are used. Besides these there are many varieties of letter, such as Old English, and imitations of manuscript letters, the mention of which could only be serviceable to the practical printer. Types are of various sizes, the following being those in use among British

printers for bookwork: English, Pica, Small Pica, Long Primer, Bourgeois, Brevier, Minion, Nonpareil, Pearl, Diamond. English has 5½ lines and Diamond 17 lines in an inch. (See *Type*.)

Composing.—The twentieth century has seen a great change in the work of the compositor, owing to the gradual perfection of mechanical methods of composition. However, for specially fine editions and work of a complicated nature, the older method of hand-setting is still employed, when the compositor picks up the types from their respective boxes, as required to give the words in the author's manuscript that has been supplied to him. The types are lifted by the right hand and placed in a composing-stick held in the left. The composing-stick is a sort of box wanting one side, and having one end movable to enable it to be adjusted to any required length of line. When the words in the stick have increased till they nearly fill the space between the ends, they are 'spaced out', that is, the blanks between the words are so increased or diminished as to make them exactly do so. Line is in this way added to line till the stick is full, when it is emptied on to a flat board with edges, called a *galley*.

Mechanical composition is accomplished in several ways, by various makes of machine. The machines principally used are of two classes: the linotype, intertype, and other machines which produce each line as a complete unit; and the monotype, which produces single types assembled into lines. These machines are constructed upon wholly different principles (see the illustrations under the headings *Linotype* and *Monotype*); they are in general use in most large printing houses, as, the type not requiring to be distributed, but being simply melted for recasting, there is no accumulation of material as in the case of hand-set type.

The linotype and intertype, line-casting machines, are based upon the principle of the assembly of independent letter-matrices into lines, and the casting of solid lines of type. The matrices are held in rest in the channels of a magazine at the top of the machine, and are released singly as required by an escapement operated by the depression of the keys in a typewriter frame at the front of the machine. They are assembled into line by a travelling band which deposits them in order in an assembly-block. The line of matrices is then spaced out to fill the line exactly, and carried before and clamped over the mouth of the body-mould and metal-pot. A plunger in the metal-pot squirts the molten metal into the body-mould and up against the matrix face. The solid line as cast is then trimmed by knives to remove superfluous metal, and pushed out

on to a tray, or galley, into its consecutive order. After the cast is taken the matrices are lifted to the top of the machine, and distributed automatically back into their respective channels in the magazine, the distributing mechanism selecting the matrices and dropping them into their correct channels.

This type of machine is mostly used for newspaper printing and for composition in narrative form. The column rules in tabular work operate to its disadvantage, as they necessitate the breaking up of the full line into a number of short ones between the rules. The product of the machine, being in solid lines, is very easily handled, and much time is saved by its use for suitable work. The number of different characters possible in modern machines with one magazine is 180, and machines are now obtainable with as many as four magazines superimposed, thus furnishing a large variety of type-sizes and faces.

The monotype machine consists in reality of two quite distinct machines—the keyboard and the caster. The keyboard resembles a typewriter, but the depression of a key causes a slight escape of compressed air through certain channels, with the result that two small punches are blown up and two holes perforated in a spool of paper carried on the machine. The position of these two holes on the strip of paper determines the letter which will be cast when the paper is subsequently carried through the casting-machine. The operator types his 'copy' as on a typewriter, each key-depression causing the respective pair of holes to be punched. At the end of each line an indicator on the machine shows the width of space necessary between the words to fill the line completely, and the operator depresses the necessary keys to cause this size space to be used.

The strip or spool of paper, which has been unwound and rewound on the keyboard as the work progressed, is then taken to the casting-machine, and, starting from the end, is again unwound and rewound by this machine. As this progresses, each pair of holes in passing permits the momentary escape of two currents of compressed air, which, by means of some very delicate mechanism, operate the movement of a die-case containing the matrices, bringing the correct matrix to position over the mould. Molten metal is pumped in automatically, and the letter cast. Each letter as cast is assembled in line on to a galley, and each line as completed is moved forward to enable a new line to commence.

This machine is in very common use, as it is capable of producing almost any kind of type-matter; while, its production being in single letters, the correction of mistakes is facilitated.

The 'copy' having now been reproduced in type, either by hand-setting or mechanically, the matter is proofed, that is, an impression is printed from it, and this goes into the hands of the printer's reader. The reader compares the proof with the author's manuscript and corrects the compositor's errors. When these have been put right, a fresh proof is taken and is sent to the author for his inspection. A large portion of the modern compositor's work consists in making the corrections that have been indicated on the reader's and the author's proofs, in arranging the types in pages, in imposing these pages in formes, and in dressing the formes for press. These processes are so varied and intricate—in them so much of *mind* is required—as to be beyond the range of machinery.

When the pages of a book are finally passed by the author as correct, they may be arranged either for casting (done by stereotype or by electrotpe process) or for going to press to be printed from. If the former, they are fixed in a rectangular frame of iron, or *chase* (q.v.) as it is called, by means of wedges, and sent to the foundry. If the latter, so many of them as are required to cover the sheet of paper to be printed on are fixed in a correspondingly larger frame and sent to the printing-press or machine. The pages thus arranged and fixed in the chase are called a *forme*. They are placed in such order that when the impression is taken off, and the sheet folded, the pages will follow each other in proper order.

When there are more sheets than one in a work, it is advisable to have these readily distinguishable from each other. To secure this, letters or numbers (called *signatures*) are placed at the bottom of the first page of each sheet, A or 1 for the first sheet, B or 2 for the second, C or 3 for the third, and so on. Thus, by merely looking at the signature the binder of the book can be sure that the sheets follow in proper sequence.

When the required number of copies has been printed from a forme of movable type, or when casts have been taken from the pages, the chase is carried back to the composing-room, and the compositor, in the case of hand-set work, undoes the work that was formerly done, by *distributing* all the types, that is, putting them back into their respective cells in the case. They are then ready for further combinations as required.

Stereotype, Electrotpe.—Instead of printing direct from type, after it has been set up in pages, it has long been common to take casts from the surfaces of the pages of type and print from these casts, two processes—stereotype and electrotpe—being employed. The former (from

Gr. *stereos*, solid, *typos*, print or form) is a process that consists in using a stucco or paper mould to obtain a cast of the surface of arranged types, which cast, or stereotype plate, is used in the printing-press exactly as types are used, and, being kept, may serve at any time to throw off an additional impression. The originator of the process was William Ged, a jeweller of Edinburgh, whose efforts to introduce it lasted from about 1725 to his death in 1749. He made an engagement with the University of Cambridge to print Bibles and Prayer-books; but the plan received so much opposition from the workmen, in making errors and batters, that it was discontinued. The same idea was taken up by Tilloch and Foulis of Glasgow (the latter a famous printer); a number of small volumes were stereotyped and printed by them. Firmin Didot of Paris also adopted the process, and in the early part of the nineteenth century it had become fairly common. It has now long been in general use, and has been of immense service in the production of cheap books and newspapers. It saves the tear and wear of types, it saves the publishers from printing more copies at a time than may be required, and from resetting the type (or keeping it standing as set) when more copies are demanded, and has other advantages. Formerly the stucco or gypsum process was the one always employed—the process of taking a cast or mould from each separate page of types by means of stucco (plaster of Paris or gypsum). The face of the page of type being perfectly clean, and previously rubbed with an oily composition or plumbago (to prevent sticking), plaster of Paris in a liquid state is poured evenly over the whole surface, and soon becomes perfectly solid. The mould, of course, shows in intaglio—that is, sunk in its surface—an exact reproduction of the page of types, and when it has been baked, so as to be perfectly dry and hard, a cast is taken from it in metal, so that the type-surface is reproduced in relief and can give an impression in the printing-press. Much nicety is required in forming the mould and removing it from the type. If any part of the plaster adheres to the face of the type, the mould is imperfect and the operation has to be gone over again. Also, the best casting cannot prevent occasional defects in the face of the plate, and it requires, therefore, to be minutely examined by workmen called pickers, who can insert a new letter if one be broken and remedy various other defects. For some kinds of work, especially newspaper work, this process has been superseded by the paper or papier-mâché process, which is much more expeditious. By it plates can be produced in a few minutes; the type from which the moulds are originally taken

lasts longer; and in cases where reprints are often required the moulds are light, inexpensive, and easily stored, so that the metal plate may be melted down and recast from the mould when a new edition is required. The mould in this process consists of several sheets of tough, thin, tissue paper, gummed together and moistened, and backed with a sheet of fine-grained brown paper. With this an impression is obtained by pressing it on the types, care being taken to drive the paper thoroughly into all the hollows between them. The back of the matrix or mould receives a coating of stucco to fill up all irregularities, and, the mould being dried, a cast from molten type-metal is easily obtained. The cast has to be carefully examined as in the stucco process. The paper mould can easily be detached from the plate uninjured, and may be used again if fresh plates are required. In the electrotype process a mould or matrix is first taken from the page of type, the substance most commonly employed being wax. This is placed in a solution of a copper salt, and by means of an electric current (see *Electro-plating*) a coating of copper is deposited on the matrix. A sort of copper shell is thus produced, one side giving a facsimile of the page of type, the reverse side being hollow, requiring to be filled with molten metal so as to form a plate that can be printed from.

Printing.—When the forme of types has been prepared for press by the compositor, it is passed over to the pressmen, who form a distinct craft. The act of printing has two operations. First there is the application of ink to the face of the types, and then the pressing of a sheet of paper on the types with such weight as to cause the ink to adhere to it. The ink used is a thick viscid fluid made of boiled linseed-oil and lamp-black. It is applied to the type by means of a roller covered with an elastic composition of glue, glucose, sugar, and glycerine, rubber being used occasionally. When the printing is being done on a hand-press, the roller is carried on a light frame having handles, by which it is gripped by the hands of the pressman or printer, who in working passes the roller several times over an inked table, and then backwards and forwards over the forme. When the printing is done on a machine, two or more rollers are placed in suitable bearings, and generally the forme is made to travel under them and receive ink in passing. In hand-printing the paper is placed and the pressure given by a second workman. In machine-work the sheet may be placed by an assistant, or taken in by the machine itself, or otherwise supplied by a continuous web from a reel.

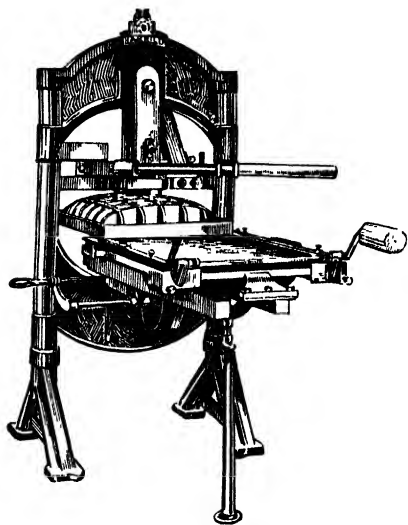
These operations, purely mechanical, have, however, to be preceded by a stage of preparation called *making-ready*, which calls for more

or less skill and taste from the workman. His craft in plain work is to produce printed sheets, the letters or reading on which shall be sharp yet solid, with the colour or depth of black uniform all over the sheet, and each sheet uniform with the others which are to form the book. This is attained partly by properly regulating the supply of ink, but mainly by getting uniformity of pressure, as any portion of a sheet more firmly impressed than another will bring off more colour.

Mechanism of Printing.—The mechanism of printing, at first of a very simple kind, has latterly attained to great perfection and efficiency. Three methods are followed for obtaining the impression which produces the printed sheet. The first and simplest is by the advance toward each other of two flat surfaces, one (the bed) carrying the type-forme, the other (the platen) carrying the blank sheet to be printed. The second is by the rotation of a cylinder above a type-table travelling backwards and forwards, the table being in contact with the cylinder in advancing and free in returning. The third and most recently adopted method is the contact of two cylinders revolving continuously in the same direction, one carrying the type-surface and the other bringing against it a continuous web of paper, which it afterwards cuts into sheets. Presses or machines of the first class are called *platen*, the second *cylinder*, and the third *rotary*.

The press used by Gutenberg was of a very rude description, the ink being applied by means of leather-covered balls stuffed with soft material, and having suitable handles, and the pressure being obtained by a screw which brought down a flat block or platen. The first improvement on this device seems to have been the construction of guides, enabling the type-forme to be run under the impressing surface and withdrawn with facility. Other necessities soon after arose, chiefly that of obtaining a rapid return of the platen from the position at which it gave the pressure, without the screw requiring to be turned back; but it was not till the year 1620 that this was met by the invention of Willem Janszoon Blaeu, a native of Amsterdam. Charles Stanhope, the third Earl Stanhope, was the author of the next great improvement in printing-presses, about 1800. He devised a combination of levers, which he applied to the old screw-press. These levers brought down the platen with greatly increased rapidity, and, what was of still greater importance, converted at the proper moment that motion into direct pressure. The pressure was under control and capable of easy adjustment. The press was of iron, not of wood as was the case with all previously constructed presses, and it exhibited a

number of contrivances of the most ingenious character for facilitating the work of the pressman. In 1813 John Ruthven, a printer of Edinburgh, patented a press on the lever principle, with several decided improvements. The Columbian Press, invented in 1814 by G. Clymer, Philadelphia, and the Albion Press are among later contrivances, and are still in use to a limited extent. Even in its best form the hand-press is laborious to work and slow in operation, two workmen not being able to throw off more than 250 impressions in an hour. It therefore became imperative, especially for newspapers, to



Albion Press

devise some more expeditious and easy method of taking impressions from types.

So early as the year 1790 William Nicholson took out letters-patent for printing by machinery. His printing-machine never became available in practice, yet he deserves the credit of being the first who suggested the application of cylinders and inking-rollers. About ten years later König, a printer in Saxony, turned his attention to the improvement of the printing-press, with a view chiefly to accelerate its operation. Being unsuccessful in gaining assistance in his native country to bring his scheme into operation, he came to London in 1806. There he was received with equal coldness, but ultimately, with the assistance of Thomas Bensley, he constructed a machine on the platen or hand-press principle. Afterwards he adopted Nicholson's cylinder principle, and succeeded in producing a machine which so satisfied John Walter, proprietor of *The Times* newspaper, that an agreement was entered into to erect two to print that journal.

On 28th Nov., 1814, the reader of *The Times* was informed that he held in his hand a paper which had been printed by machinery moved by the power of steam, and produced at the rate of 1800 impressions per hour. This is commonly supposed to be the first specimen of printing executed by steam machinery; but König's platen machine was set to work in April, 1811, and 3000 sheets of signature π of the *Annual Register* for 1810 were printed by it. That was undoubtedly the first part of a book ever printed by machinery.

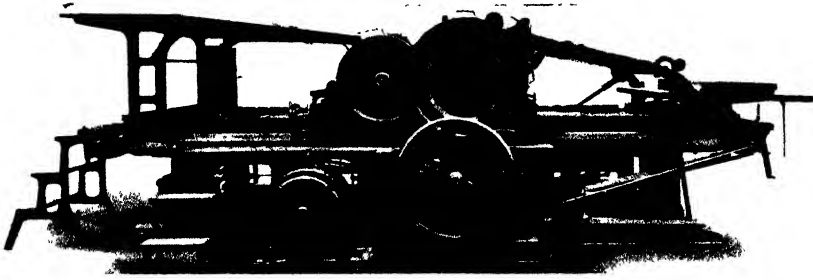
A further improvement was made in May, 1848, by Applegath. His machine, which printed 10,000 impressions per hour, had a vertical cylinder 65 inches broad, on which the type was fixed, surrounded by eight other vertical cylinders, each about 13 inches diameter and covered with cloth, round which the paper was led by tapes, each paper or impression cylinder having a feeding apparatus and two boys tending. The type used was the ordinary kind, and the forme was placed on a portion of the large cylinder. The surface of the type formed a portion of a polygon, and the regularity of the impression was obtained by pasting slips of paper on the impression cylinders.

Few machines, however, of this construction were made, a formidable rival having appeared, devised by Messrs. Hoe & Co. of New York, which was introduced into many newspaper offices in Great Britain. It was constructed with from two to ten impression cylinders, each of them printing from a set of types placed on a horizontal central cylinder of about $6\frac{1}{2}$ feet in diameter, a portion of which was also used as a cylindrical ink-table, each of the encircling cylinders having its own inking-rollers and separate feeder. A machine of this construction, having ten impression cylinders, threw off at the rate of 18,000 impressions or more an hour. Afterwards stereotype plates fitted to the curvature of the cylinder were used with great advantage.

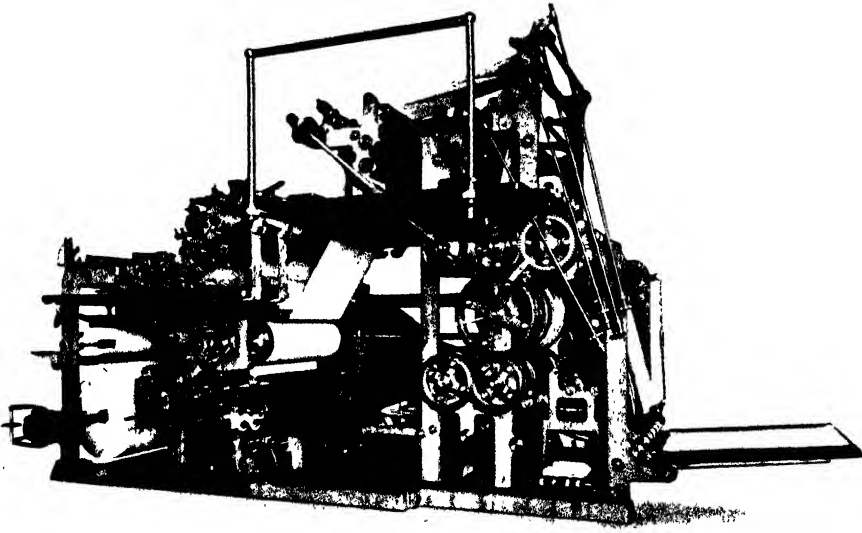
Repeated attempts were made by inventors to construct a machine which would print from the continuous roll or web in which paper is supplied by the paper-making machine. Experiments were conducted successively by Nicholson, Stanhope, Sir Rowland Hill, Applegath, and others, but the difficulties for the time proved insurmountable. These, however, were at length overcome, and the result is the construction of a class of machines which possess the merit of being at once simpler, more expeditious, and more economical in requiring less attendance than any previous contrivance.

The first machine on the web principle that established itself in the printing-office was the

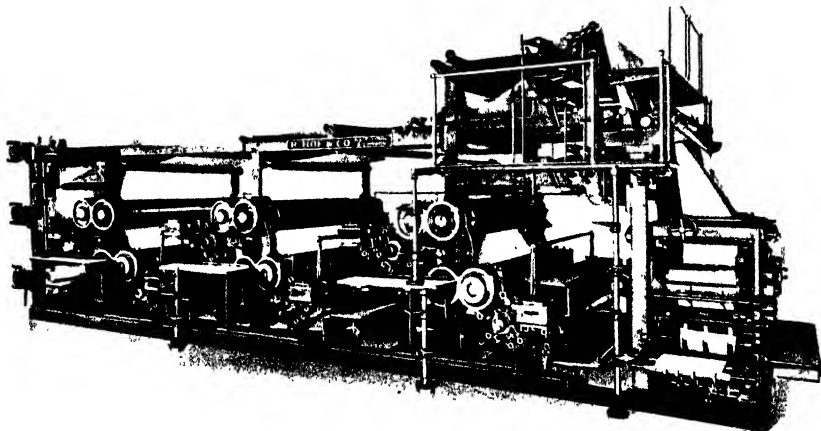
PRINTING MACHINES



Miehle Perfector Printing Machine



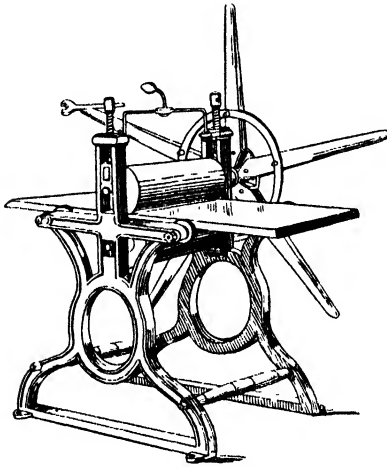
Rotary Web Offset Printing Machine



Superspeed Sextuple Newspaper Printing Machine

'Bullock', an American contrivance. It was, however, speedily eclipsed by the 'Walter Press', invented and constructed on the premises of *The Times*. This printed from a web about 4 miles long, delivered the papers separately, printed on both sides, but not folded: folding was afterwards added. Various other rotary machines have been invented and brought into extensive use. Of these may be mentioned the machines by Marinoni of Paris, and Messrs. Hoe & Co. of New York.

In 1885 the latter patented combinations of two or more printing-machines for producing at will papers of various sizes or numbers of pages, besides introducing other improvements.



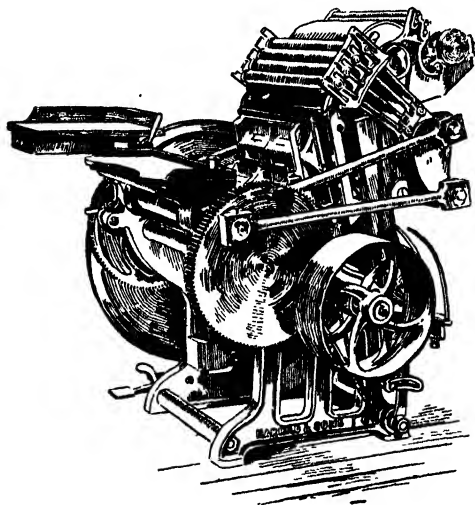
Copper-plate Press

In this way three similar machines might be connected by tapes, and might all be employed independently to produce four- or eight-page papers, in each case folded; or twelve-page papers, by passing four-page sheets from one to another machine alternately, where they were associated and folded with the eight-page papers; or sixteen-page papers, or other combinations. Then was introduced a new era in fast newspaper printing. The adoption of stereotyping had made it a simple matter to employ as many machines on a newspaper as were required to print it in the allotted time; but these machines could print only papers of four and eight pages; separate printings were required for papers of twelve pages. It was an enormous advantage to provide machinery that would print newspapers of a varying number of pages, from four to twelve or sixteen, or even more, all inset, cut at the head, and folded in a convenient form. Among recent arrangements are the erection of two presses at right angles to each other, forming one machine,

and the placing of two or more presses above each other, with connections between them—thus giving 'two-decker' and 'three-decker' machines. There may be also two or more presses placed one behind another, and capable of being coupled to form a combined machine on the 'tandem' system. There are now presses that produce papers of four, six, eight, ten, twelve, and up to thirty-two pages, all cut at the head and folded to quarter-page size. Some machines produce four- to eight-page papers at the rate of 96,000 per hour; sixteen-page papers at the rate of 48,000, and twenty-four page papers at 24,000. There are also web machines which print the inside of a magazine and the coloured wrapper, folding and sewing them at the same time. Other machines print in several colours simultaneously. One machine of Hoe & Co.—the Sextuple Press—prints from three rolls of paper each double the width of the newspaper, and in the case of an eight-page issue at the rate of 72,000 copies per hour, the papers all being folded ready for publication. This machine may also be used for printing in three colours simultaneously. In this case only one roll of paper is supplied, and three electrotypes of the colour-plates are placed on the cylinders, instead of the stereotypes from the letterpress. Many book-printing offices make use of a 'perfecting' cylinder machine, i.e. a machine which prints the sheet on both sides before ejecting it. By means of an ingenious arrangement of tapes and cylinders the sheet is first printed on one side and then on the other, the formes of type being laid horizontally on a carriage or table, which receives a reciprocating movement, and which corresponds in office to the table of the common hand-press. A remarkable development in bookwork, for the production of the cheap pocket series now so popular, is the parallel installation of six rotary machines, each carrying a load of 96 pages, at one end of a specially built large factory, with gathering, sewing, blocking, binding, and other necessary machines in sequence, by which it is possible to convert reels of paper into bound books of 576 pages (or lesser multiples of 96), each in its pictorial wrapper, in less than half an hour.

The machines hitherto described have been of the cylinder class and of the outcome of that class—the rotary. The *platen* or flat-surface printing-machine is chiefly used as a jobbing machine, and has for its aim the production of work equal in quality to that produced by the hand-press, and at a greater speed. It is constructed upon the same principle as the hand-press so far as the mode of taking the impression is concerned, but in its modern form is distinguished from that press in that the bed of the forme and the platen are vertical

instead of horizontal, while the whole of the operation of printing is automatical, the attendant having simply to lay the paper to be printed to a gauge and remove it when printed. For some makes of this type of machine an automatic feeding attachment is supplied, and automatic delivery renders even taking off unnecessary. Great improvements have been recently made on platen machines, which are sometimes worked by a treadle, but more commonly by steam, electricity, &c.—BIBLIOGRAPHY: C. H. Timperley, *Dictionary of Printers and Printing*; W. Skeen, *Early Typography*; W. Blades, *Biography and Typography of William*



Platen Machine

Caxton; R. Dickson and J. P. Edmond, *Annals of Scottish Printing*; E. G. Duff, *Early English Printing*; H. R. Plomer, *Short History of English Printing*; C. T. Jacobi, *Printing*; J. Southward, *Modern Printing*; H. G. Aldis, *The Printed Book*.

Prior, Matthew, English poet and diplomatist, was born in Dorsetshire in 1664, and died in 1721. His father was a joiner. In those days learning and satirical abilities were sure roads to success, and Prior owed his good fortune to these qualities. He was caught by the Earl of Dorset in the act of reading Horace, and was sent to Westminster, and St. John's College, Cambridge, where he graduated B.A. in 1686, becoming a Fellow in 1688. His witty parody of Dryden, *The Hind and the Panther transvers'd to the Story of the Country Mouse and the City Mouse*, written in collaboration with Charles Montagu, afterwards Earl of Halifax, won Prior much fame with the no-Popery party, and procured his admission to diplomatic posts. He was appointed secretary to the

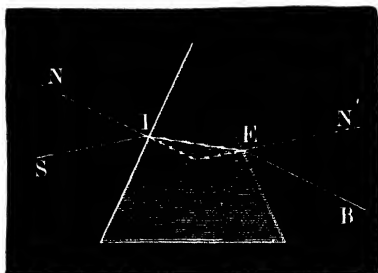
Ambassador at The Hague, and was secretary at the negotiations at the Treaty of Ryswick. He became a member of Parliament in 1701, and, having joined the Tory party in 1702, was appointed Commissioner of Customs in 1711. He played a prominent part in the peace negotiations of 1711, and the Treaty of Utrecht (1713) was popularly known as 'Matt's peace'. He became plenipotentiary at Paris in 1712, but was recalled when Queen Anne died, and was imprisoned for two years. In 1718 a folio edition of his works appeared, including his ambitious poem *Solomon*. This was intended to be his *magnum opus* in every sense of the word, for it measured 3 feet by 1 foot. He made £4000 by this book, and was presented by Lord Harley with an estate in Essex, where he lived in retirement until his death.

Prior is one of the neatest writers of occasional verse in the whole galaxy of society versifiers. His longer and his more serious poems are not of much account, except *Alma, or the Progress of the Mind*, in which he followed the Hudibrastic tradition. His metre and rhymes, however, are smoother than those of Butler. His satirical perversion of Boileau's pompous *Ode sur la prise de Namur* (Namur was taken by the French in 1692, and retaken by the English in 1695) is a masterpiece of burlesque. His intolerably stiff modernization of the delightful old ballad *The Nul-brown Maid* (rechristened *Henry and Emma* in its new avatar) is a complete failure, as are his adaptations of Chaucer. The former is an outstanding example of pouring romantic wine into classical bottles. Prior's best poems are his short and playful ones, such as *To a Child of Quality*, *A Simile*, and numerous others. In these poems he displays a lightness of touch and a finish of style which link him to the neatest of the Roman poets, to Horace and to Martial.—BIBLIOGRAPHY: W. M. Thackeray, *The English Humourists*; A. Dobson, *Eighteenth Century Vignettes*; L. G. W. Legg, *Matthew Prior: a Study of his Public Career and Correspondence*.

Priscia'nus, usually known as *Priscian*, a celebrated Roman grammarian, who lived in the latter half of the fifth century of our era, and of whom little more is known than that he was born at Caesarea, taught grammar at Constantinople in the time of Justinian, and wrote the *Institutiones Grammaticae*, an exposition of Latin grammar. His work, successively abridged by several writers, formed the basis of instruction in Latin up to the fifteenth century, and there exist at present about one thousand MSS. of it, none dating before the ninth century. It contains numerous quotations from Latin authors now lost. The first edition of his *Grammar* appeared at Venice in 1470.

Priscillian, the reputed founder of a Gnostic sect in Spain, known as Priscillianists, in the middle of the fourth century, their doctrines being a mixture of Gnosticism and Manichæism. Priscillian was himself a wealthy and accomplished man, of very temperate and strenuous habits. His followers did not leave the Catholic Church, and he was actually at one time made a bishop himself. He was ultimately executed at Treves in A.D. 385, after a prolonged struggle with the orthodox clergy. The most distinctive part of Priscillian's creed was the belief in an evil spirit as the supreme power. His sect lasted until about A.D. 600.

Prism, in geometry, a solid figure which can be generated by the motion of a line kept parallel



Light passing through a Prism

to itself, one extremity of it being carried round a rectilinear figure. A 'right prism' is one which is bounded by two planes at right angles to the generating lines, or edges. In optics a prism, most commonly made of glass and triangular in section, is an important element in many instruments. If a ray of light, SI , enter such a prism by one of the two principal faces, it is bent in passing through so as to follow the path $SIEB$. The angle which the ray in the prism makes with the normal, NI , is always smaller than the angle of incidence, NIS , and the angle which it makes with the normal, EN' , is smaller than the angle of emergence, $N'EB$, the ray being always bent towards the base of the prism. Not only is the ray thus bent, but it is also decomposed, since the angle through which a ray is bent depends upon its colour. See *Colour; Light; Refraction; Spectrum*.

Prisons in Great Britain are all maintained and managed by the State. Until 1877 the local prisons were in the hands of the local authorities, and there were none but local prisons till well on in the eighteenth century. Generally they were hotbeds of disease and vice. In practice the jailers were the managers, and they made as much profit as they could from their offices. They had no salaries, or merely nominal ones, and had to live on the profits

they made from the sale of food and drink to the prisoners and visitors. Young and old, male and female, were herded together during the day; and even at night they were not always placed in separate quarters. The efforts of John Howard, and others whom he inspired, directed attention to abuses and modified some of them. The State erected and managed prisons for convicts and certain classes of prisoners when difficulties arose as to their banishment, and when transportation was abolished additional provision had to be made.

In the earlier part of the nineteenth century inspectors of prisons had been appointed, and some of the local authorities had accepted and even improved on their recommendations; but it was ultimately decided that the public interest made it necessary for the State to take over all prisons, in order that greater uniformity in the treatment of prisoners might be ensured, that the number of prisons might be reduced, and that the cost of maintenance might be diminished. There are separate Prison Commissioners for England and Scotland. All except ex officio members are appointed by the Crown. The English Commissioners report to the Home Secretary, and the Scottish Commissioners to the Secretary for Scotland, and under those ministers respectively they manage the prisons. Their authority is limited by statutes and by statutory rules which have been approved by the minister and submitted to Parliament. All prison officers are under their direction and supervision, and they appoint, and may suspend or dismiss, subordinate officials. They inspect prison buildings, see that the rules are observed, and hear and adjudicate upon complaints by officers and prisoners. Each prison has a visiting committee, mainly composed of members elected by the local authorities. They have powers of inspection, and may make suggestions for the better management of the prisons, but they have no executive powers. The governor of the prison is its chief executive officer, and is responsible to the Commissioners for the work of the prison. The matron has authority under him, and within the female department of the prison is the chief officer. Each prison has its chaplain, a clergyman of the Established Church, and in some prisons there are also visiting clergymen belonging to other Churches, who minister spiritually to the prisoners of their religious persuasion. In England some of the chaplains are full-time officers, but in Scotland they are all engaged for part-time service, and are mainly occupied in ministering to congregations outside. The chaplains not only conduct religious services and visit the prisoners in their cells to instruct and admonish them, but they supervise the prison library and

the education of the prisoners. They also assist in aiding prisoners on discharge. Each prison has at least one medical officer, who must be a fully qualified practitioner. In the smaller prisons there is no resident doctor, the duties being discharged by a visiting man. Of all the prison officials the medical officer has probably the most real power. He can interfere, on medical grounds, with the diet, work, and treatment generally of any prisoner. It is his duty to note the physical or mental peculiarities of those under his care, and to make such recommendations for their special treatment as seem to him necessary. He attends the sick, whether they are officers or prisoners, and he has to see that the prison and the quarters are kept in a sanitary condition, and that the food supplied to the prisoners is of good quality and is properly cooked. All these officials are appointed by the minister, but are under the authority of the Commissioners. The warders come most closely and continuously in contact with the prisoners. They are required to be of sound physique, of good character, and to have passed a simple examination in general education. Only male warders are employed with the male prisoners, and only female warders with the female prisoners. They see that the routine work of the prison is carried out, supervise the prisoners when at work, see that their cells are kept clean, and attend to the warding of them.

Prisons are mostly built on the same general plan. Two blocks of cells run parallel and about 16 feet apart. They are joined together at the ends by walls containing doors on the ground-level and large windows above. The space between is roofed in with glass, and floored with tiles. All the cell doors open towards this corridor, and above the ground-flat galleries are carried round it. All the cell windows are on the other side of the block. Each cell contains about 800 or 1000 cubic feet, and is furnished with a bed, a table, a stool, and other necessary articles. It is lit during the day by its window, and at night by artificial light. It contains a bell, by means of which the warder may be summoned, and its door contains a device by which the warder can observe the prisoner when he wishes to do so. Many of the prisons are old buildings, and they differ greatly in style and in arrangement. Those recently built are much more comfortable than the prisons they have replaced. Each prison has its hospital, and some of these are very well equipped; but in Scotland it has been the practice since 1860 to send those who are dangerously ill to outside hospitals for treatment, bringing them back on recovery; and the English Commissioners have now obtained similar powers.

Insane persons are removed from prisons to

lunatic asylums, and recent legislation has ordained the same course to be followed with the mentally defective. The prisons contain persons waiting trial, certain debtors, and persons committed for contempt of court, and persons sentenced to imprisonment or to penal servitude. In theory the person charged with crime is innocent until proved guilty, and, unless held for trial on the most serious crimes, he may be admitted to bail. In practice he may find himself detained in prison through not having the means of giving a bond. The untried prisoner may have a special room and furniture assigned to him; he may have his food sent in to him; he may have visits at reasonable times, and the number of the visits is not strictly limited by rule; and he may write and receive letters. The visits must take place in the presence of an officer, who must also be in a position to hear all that is said, save when the prisoner is visited by his law agents; and the letters must all be read by a prison official. But he can only have all these privileges if he is able to pay for them. He is not compelled to do any work, but he may get work if he wishes it. He does not exercise along with convicted prisoners, nor does he associate with them. Otherwise he is subject to the prison régime. Prisoners sentenced to imprisonment, that is, with sentences of from five days to two years, are divided into classes, for certain purposes, according to the length of their sentence, or according to their age or past record. In these classes the diets, periods of exercise, and privileges differ.

All prisoners sentenced to imprisonment for periods exceeding one calendar month may earn remission of sentence, not exceeding one-sixth of the period, by good conduct and industry. Whether their sentences expire by lapse of time or by remission, they are not liable to police supervision on liberation. Convicts are persons sentenced to penal servitude for three years or more. Their sentences may be served in any part of the king's dominions; but as a rule they are kept in the country where they were sentenced, and placed in special prisons there. Their work is supposed to be more arduous than that of ordinary prisoners and the discipline more severe; but their diet is more generous and varied, and in many respects they are better off. By good conduct and industry they may gain their liberation on licence—the women when they have served two-thirds, and the men when they have served three-fourths of their sentence. The licence is better known as ticket-of-leave. It is conditional on their reporting to the police once monthly, on their producing their licence to

any magistrate or police-officer when called upon to do so," and on their abstaining from crime or association with criminals. If convicted during the term of their licence, they may be called on to serve the whole of the time for which the licence was issued. All prisoners on admission are medically examined, and it is the duty of the doctor to note any defect from which they suffer, and take steps to prevent them from being subjected to treatment that might injure them. They are bathed on admission, and at regular intervals during their imprisonment. They wear the prison clothing and occupy separate cells. The diet, if insufficient or unsuitable in any case, may be changed or increased by the medical officer. It is plain and monotonous but, if one may judge by the low sickness returns, it is healthy. Exercise is taken in the airing-yards for such time daily as is approved by the medical officer. Work varies in character in different prisons. It is never equal in strain to what is common outside, and is mainly of a kind requiring little skill for its adequate performance. Prisoners have to keep their own cells clean; and the prison work, cleaning, cooking, washing, &c., is done by them. Work is also done for Government departments. There are regular religious services, and in the winter there are concerts and lectures to vary the monotony. Each prison has a library for the use of prisoners, and those who wish to engage in special studies are afforded means for doing so. There are teachers for those whose elementary education has been neglected. Visits are made to the prisoners individually by the chaplains and by visitors from religious and philanthropic organizations.

In England there are three divisions of imprisonment. The third is the ordinary division; in the second the prisoners have some extra privileges; and in the first they are under rules similar to those governing the untried. It is possible, therefore, for a man who has money, if he is sentenced to be kept in the first division, to make himself tolerably comfortable, and have the attendance of other prisoners on him, for a sum that would not nearly defray the cost of service outside. In Scotland there is no such provision made. Convicted prisoners there all come under the same rules, and distinctions between them are not made on the ground of their social position or of the crimes they have committed, but only on their physical or mental needs.

Borstal and preventive detention institutions, though not called prisons, are places of detention for criminals, and are under the management of the Prison Commissioners. The Borstal institutions are places for the application of reformatory treatment to persons between the ages of sixteen

and twenty-one who are of criminal habits or tendencies, and who have been convicted of crime. The sentences are of from two to three years' detention, followed in all cases by twelve months' supervision. The inmates receive instruction in handicrafts and in general knowledge. The preventive detention institutions are for the detention of habitual criminals. The period of detention is up to ten years. There also the regimen is declared to be reformatory, and the inmates of both kinds of institution are much better off than the ordinary decent workman. In both cases there is provision for the licensing of the inmates. Borstal inmates may be licensed: the lads after serving six and the girls after serving three months of their sentence, if there is reasonable ground for the belief that they will lead a useful and industrious life. The conditions of the licence are simple: residence in an approved place, steady work, avoidance of bad company, and return to residence at a reasonable hour. If the licence is revoked, the person may be taken back; and if the licence-holder runs away, the time that elapses before he is brought back does not count in calculating the expiry of his sentence. A licence similar in character may be given to habitual criminals at any time. Those on licence have a large measure of freedom, while their neighbours are secured against their bad conduct by the supervision exercised over them. The guardians of the licence-holders are appointed by the Prison Commissioners, and have no connection with the police.—BIBLIOGRAPHY: E. Carpenter, *Prisons, Police, and Punishment*; J. Howard, *State of Prisons in England and Wales*; R. F. Quinton, *Modern Prison Curriculum*; George Ives, *History of Penal Methods*; A. Guillot, *Les prisons de Paris*.

Privas (prê-vî), a town of Southern France, capital of the department of Ardèche, about 6 miles west of the Rhone. Pop. 7561.

Privateer, an armed vessel owned and equipped by private individuals, and furnished with letters of marque authorizing the seizure and plunder of the ships of an enemy. Letters of marque are an essential feature, otherwise the ship is considered as a pirate, and may be treated as such if captured. Letters of marque were first granted in England during the reign of Henry V, in view of the war with France; and they were issued to aggrieved subjects in order that they might compensate themselves for injury done by foreigners. In the sixteenth century it became common to grant commissions to privateers. England, Holland, and Spain, as the three principal naval powers, used this effective weapon freely; and France also sent out privateers in every war in which she was engaged. A neutral is not forbidden by the law of nations to accept

a commission for privateering; but he may be, and generally is, by treaty. Since 1870 British subjects have been forbidden to accept such commissions. By the Declaration of Paris, 1856, the great powers of Europe mutually agreed to abandon the right to arm privateers in case of war; but several nations, the chief among them being the United States and Spain, did not agree to this, and it is doubtful whether it will always be strictly acted upon even by the parties to the declaration. The German volunteer fleet of 1870 can not clearly be distinguished from a collection of privateers. The practice of privateering, while useful to maritime countries, is very harassing to trade, and gives endless opportunities for private plunder. It was probably in deprecation of irresponsible warfare of any kind that the powers agreed to abandon privateering in 1856.

During the European War Great Britain's armed merchant-cruisers were theoretically naval vessels, but in actual practice there was little to distinguish them from the privateers of bygone days. The *Moewe*, equipped by Germany, was not so much a pirate as a privateer. It is very difficult to draw a dividing-line between these two equally obnoxious and parasitical modes of maritime warfare. See *Pirate; Navy*.

Privet (*Ligustrum*), a genus of plants of the ord. Oleaceæ. The common privet (*L. vulgäre*) is a native of Europe, growing 8 or 10 feet high; the leaves are elliptico-lanceolate, entire, and smooth; the flowers slightly odorous, white at first but soon changing to a reddish-brown; and the berries dark purple, approaching black. This species is much used in gardens for ornamental hedges. There are numerous other species, many of them being natives of China and other Asiatic countries.

Privilege (Lat. *privilegium*), a particular exemption from the general rules of law. This exemption may be either *real* or *personal*: real, when it attaches to any place; personal, when it attaches to persons, as ambassadors, members of Parliament, clergymen, lawyers, and others. Real privilege is now of little importance; personal privilege, however, is guaranteed in certain cases to many classes of individuals. For instance, suitors and counsel are exempt from arrest while in court; and members of Parliament while in the House of Commons.

Privy Council, the Council of State of the British sovereign, convened to concert matters for the public service, and for the honour and safety of the realm. The English Privy Council may be said to have existed from times of great antiquity; but the *concilium ordinarium*, established by Edward I, was the parent of the modern institution. It consisted of the chief ministers, judges, and officers of State, and

grew in power and influence rapidly, though repeatedly checked by jealous Parliaments. This ordinary council assumed the name of Privy Council during the fifteenth century, and in 1640 the Long Parliament deprived it of many of its arbitrary and insufficiently defined powers. Under the Tudors and the first two Stewart sovereigns the great powers of the council—legislative, administrative, and judicial—were used to the utmost in the interests of the Crown; but from the Restoration to the present time this ancient body has gradually retired more and more into the background of national politics, especially since the rise of the Cabinet. The Privy Council of Scotland was absorbed in that of England at the Union. As it exists at present, the number of members of the Privy Council is indefinite; they are nominated by the sovereign at pleasure, and no patent or grant is necessary, but they must be natural-born subjects. The list of Privy Councillors now embraces, besides the members of the royal family and the members of the Cabinet, the archbishops and the Bishop of London, the great officers of State, the Lord Chancellor and chief judges, the Speaker of the House of Commons, the First Lord of the Admiralty, the Colonial Premiers, and other persons who fill or have filled responsible offices under the Crown, as well as some who may not have filled any important office. Officially at the head is the Lord President of the Council, who is appointed by patent, and who manages the debates and reports results to the sovereign. A member of the Privy Council has the title of 'right honourable'. It is only on very extraordinary occasions that all the members attend the council, and it is not now usual for any member to attend unless specially summoned. The attendance of at least six members is necessary to constitute a council. Privy Councillors are by their oath bound to advise the Crown without partiality, affection, or dread; to keep their counsel secret, to avoid corruption, and to assist in the execution of what is resolved upon.

While the political importance of the Privy Council, once very great, has been extinguished by the growth of the system of party government, it still retains functions both administrative and judicial. The former is chiefly exercised by means of committees of the council, which have certain statutory duties apportioned to them. The Board of Trade is still nominally at least regarded as one of these committees. Another is the judicial committee of the council, a body established in 1833, and consisting of the Lord Chancellor and other judges, some being Indian or colonial. Four members constitute a quorum. Later legislation tends to assimilate this committee with the House of

Lords as final judges of appeals. Barring some not important original jurisdiction, the judicial committee of the Privy Council is a final court of appeal from India and the colonies, the Channel Islands, and the Isle of Man, while within the British Isles it has supreme appellate jurisdiction in ecclesiastical cases. A special committee of the council was long at the head of all educational matters in Britain. It was first appointed in 1839 for administering the grants which for a few years the Government had made with a view to meet the educational wants of the country. It included the President and Vice-President of the Council, the latter of whom held the position of Minister for Education. Under this department the parliamentary grant was distributed, the educational code framed or altered, the inspectors of schools appointed, &c. Since the year 1900 the Board of Education has taken the place of this committee.

Orders in council are orders issued by the sovereign, by and with the advice of the Privy Council, either by virtue of the royal prerogative, and independently of any Act of Parliament, or by virtue of such Act, authorizing the sovereign in council to modify or dispense with certain statutory provisions which it may be expedient in particular conjunctures to alter or suspend.—BIBLIOGRAPHY: W. Stubbs, *Constitutional History of England*; A. V. Dicey, *The Privy Council*; Lord E. Percy, *The Privy Council under the Tudors*; *Acts of the Privy Council* (editor, J. R. Dasent).

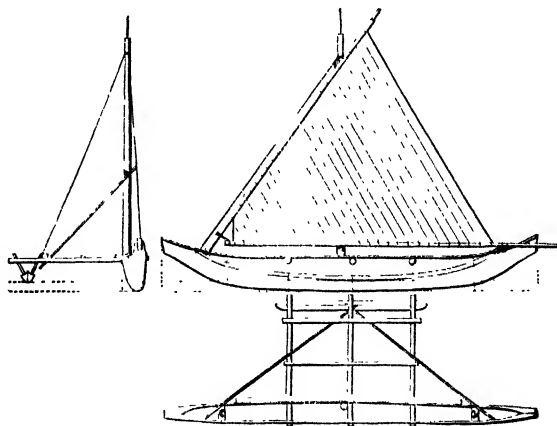
Privy Purse, Keeper of the, an officer of the royal household of Great Britain, whose function it is to take charge of the payment of the private expenses and charities of the sovereign. The amount of money granted to the king and queen for their own personal expenditure was fixed in 1910 at £110,000 a year.

Privy Seal, a seal appended by the British sovereign to such grants or documents as are afterwards to pass the Great Seal. Since the time of Henry VIII the Privy Seal has been the warrant of the legality of grants from the Crown, and the authority for the Lord Chancellor to affix the Great Seal; such grants are termed letters-patent. The officer who has the custody of the Privy Seal is called Lord Privy Seal, and is the fifth great officer of State, having also generally a seat in the Cabinet.

Prize, a term applied to all captures of property made in virtue of the rights of war. Property captured on land is usually called *booty*, the term prize being more particularly used with reference to naval captures. The right of belligerents to capture the property of

their enemies on the sea is universally admitted, as well as the right to prevent violation of the law of nations by neutrals, so long as the independence of other nations is not interfered with. It is accordingly settled as a principle of the law of nations that every belligerent has a right to establish tribunals of prize, and to examine and decide upon all maritime captures; and likewise that the courts of prize of the captors have exclusive jurisdiction over all matters relating to captures made under the authority of their sovereign. The sentence of a court of competent jurisdiction once pronounced is conclusive and binding on all nations. Questions of naval prize-money in England are adjudicated by the Courts of Admiralty. The 27 and 28 Vict. c. xxv (1864) regulates the proceedings in the case of a naval prize. The captive ship is delivered up to the court without breaking of bulk; and if the capture is adjudged legal, is sold for the benefit of the captors, among whom the proceeds are divided according to their rank.

Prize Court. In time of war each belligerent country establishes a court of law, known as a prize court, to determine the validity of the capture by its naval forces of ships and goods at sea. The rules of procedure of these courts are not necessarily identical in each country, but their decisions should accord with international law. In Britain an appeal lies to the Judicial Committee of the Privy Council. **Prize**, i.e. enemy property captured at sea, belongs to the Crown, but prize-money is paid to the officers and men of the navy out of the net proceeds of the sale of such property.



End View, Side View, and Plan of a Proa

Proa, a form of sailing-vessel used in the Malay or Eastern Archipelago and in the Pacific. It is variously constructed, but regularly has

one side quite flat, on a line with the stem and stern, while the other side is curved in the usual way; and being equally sharp at stem and stern, it sails equally well in either direction without turning. Their shape and small breadth of beam would render them peculiarly liable to upset were it not for the outrigger they carry, adjusted sometimes to one side and sometimes to both sides. The outrigger in the example here shown is a large structure supported by and formed of stout timbers. The outrigger may have weights placed on it and adjusted according to circumstances. Proas carry a lugsail generally of matting.

Probabilism (Lat. *probabilis*, from *probare*, to prove), the theory that probable opinions may be used as a guide to conduct, and that a layman is free to accept either course of action in the case of a divergence of opinion among recognized authorities. According to probabilist teaching, an action is neither sinful nor wrong if there is a probability that it is right and lawful. In other words, in the case of a doubt concerning only the lawfulness or unlawfulness of an action, we may safely follow the opinion of a weighty theologian in favour of liberty, and may be morally sure that we are acting lawfully. Probabilist tendencies are found among the Sophists, but the doctrine was first clearly defined by the Dominican Bartholomew de Medina in the sixteenth century, and was utilized by the Jesuits. The doctrine was attacked as immoral by the Jansenists, and Pascal exposed the system in his *Lettres provinciales*. In later times Alfonso de Liguori was the greatest champion of probabilism. See *Casuistry*.—Cf. H. C. Lea, *History of Confession and Indulgences*.

Probability. The probability of a future event is the likelihood that it will happen. The probability of a statement is the likelihood of its truth. To an omniscient being, the idea of probability would have no signification; in fact the whole theory of probability is based on the assumptions that we are ignorant of some facts and aware of others, and that from the facts that we know we can reason as to the likelihood of the truth of assertions about unknown facts. Thus the theory of probability has a subjective element, and writers on the subject have distinguished between subjective or 'moral' probability, and 'mathematical probability', an exact science, based on certain principles which exclude psychological considerations. The mathematical theory of probability dates from 1654, when certain questions regarding a game of chance were investigated by B. Pascal at the instance of the Chevalier de Méré (a reputed gamester). Analogous problems were discussed by Pascal, Fermat, Huygens, De Moivre, the Bernouillis, and

other eminent mathematicians of the seventeenth and eighteenth centuries, some of whom published systematic treatises on the subject, but the classical work is the great *Théorie analytique des probabilités* of Laplace, published in 1812. This author bases the theory on a First Principle, which is really a definition, and may be thus expressed: 'If an event may happen in a ways and fail in b ways, and all these ways are equally likely to occur, the probability of its happening is $a : a + b$.' To illustrate this, consider the case when a ball is taken at random from an urn containing one black and two white balls; the probability that a white ball will be drawn is $\frac{2}{3}$, for there are three possible events, each equally likely, and two of these consist in drawing a white ball. This definition has been objected to because the phrase *equally likely* means *equally probable*, so that the definition involves a logical circle. Peano has proposed to amend the definition by omitting the objectionable phrase; but apparently this would cut adrift the mathematical theory from any relation to 'moral' probability. If, however, we are dealing with events that can be repeated an indefinitely great number of times, and if the ratio of the number of favourable cases (when an event of the specified class occurs) to the total number of trials tends to the ratio previously mentioned as a limit, then the connection between the mathematical theory and possible applications will be established, and we shall have a mathematical criterion for 'equal likelihood'. Various experimental tests of this assumption in simple cases have been made by actually carrying out a large number of successive trials. K. Pearson tossed coins for 'heads or tails', and Professor Weldon threw a die and recorded the frequency with which three or four spots turned up. A very distinct approach towards the theoretical limit was in each case observed; but it is to be noted that the theory of probability, like all other mathematical theories, deals with purely abstract conceptions, and the real test of its value depends on the number and importance of the concrete cases in which the conclusions derived from its application are found to agree sufficiently closely with the results of experience.

According to Laplace's definition, a probability amounting to certainty would be measured by 1. Again, if p denotes the probability that a certain event will happen, or that a certain statement is true, $1 - p$ measures the probability that the event will *not* happen or that the statement is untrue. The theory of probabilities applies not merely to future events, but to past events, provided the latter are supposed unknown. The ratio $p : 1 - p$ is sometimes called the 'relative probability'. It is large if p is nearly equal to 1.

From his first principle or definition, Laplace deduces logically certain other principles which facilitate the calculation of the probabilities of compound events. The most important of these may be stated thus: (1) If p and q are the separate probabilities of two mutually exclusive events, then $p + q$ is the probability that one or other of these events will occur. (2) If p and q are the separate probabilities of two independent events, then pq is the probability that both will occur. Corollaries: the probability that the first will occur and not the second is $p(1 - q)$, and that neither will occur, $(1 - p)(1 - q)$. The theory of inverse probabilities has important practical applications. If an event has happened which is known to be the result of one only of a set of possible antecedents A_1, A_2, A_3, \dots whose a priori probabilities are p_1, p_2, p_3, \dots , and if q_r is the probability that A_r , if it occurs, will be followed by the observed event, then, after the event, the probability of A_r being its cause is $p_r q_r / (p_1 q_1 + p_2 q_2 + p_3 q_3 + \dots)$.

When the occurrence of an event whose probability is p is associated with a certain value V (monetary or otherwise), pV is the mathematical expectation associated with it. For example, if one is to draw a ball from an urn containing a white and b black balls, and receive a prize of £ c if a white ball is drawn, the expectation would be £ $ac/(a + b)$. This, according to theory, would be an equitable payment for the privilege of drawing. D. Bernoulli applied this theory to his famous 'Petersburg Problem', and finding the results inconsistent with good sense, he made a distinction between *mathematical* and *moral* expectation, on the ground that the true value of an increase of fortune diminishes as the fortune itself increases. From a particular hypothesis he deduced that the *moral* value of a probable gain is measured by the logarithm of the actual value.

Laplace and others developed the idea of moral expectation, and deduced the advantage of insuring, and the disadvantage of gambling, even if the game is mathematically equitable.

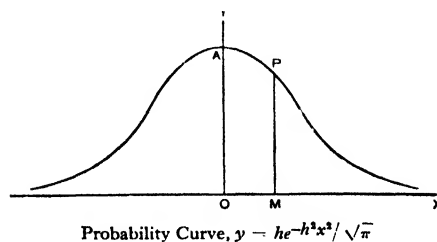
The mathematical theory of probability has been applied with success to determine the most probable value deducible from a number of independent observations of the same quantity, and the probable error in the result; also to the interpretation of statistics as bearing on such actuarial problems as insurance and life annuities. K. Pearson and his school have applied the theory to problems of biology, in particular to the proof of the existence of correlations between certain biological characters. The correspondence between the known properties of gases, and results deduced by the aid of the

probability-calculus from the theory that a gas consists of an immense number of flying molecules, is a striking confirmation of the exactness of probability-calculations when very large numbers of events are dealt with.

The weight to be attached to the combined testimony of several witnesses, assuming that we know the probability that any witness is speaking the truth, is a branch of the theory that has received some attention.

Law of Error.—The Law of Error, or of Frequency of Error, is thus expressed: $y = he^{-h^2x^2}/\sqrt{\pi}$, where ydx is the measure of the probability that in a large number n of observations of the same magnitude any error will lie between x and $x + dx$, so that $nydx$ will be the number of the observations we should expect to have that amount of error. Here h is a constant, depending on the method of measurement or observation employed, and is called the *precision* of the series of observations in question. For a given method, h increases with n , being proportional to \sqrt{n} . It can be determined by certain rules for any given set of observations, provided they form a *normal series*, as they do in most cases when a skilled observer makes a series of observations of a physical quantity. The law applies only to 'accidental errors' which remain after all 'systematic errors', such as extension of measuring-rods due to rise of temperature, have been allowed for. The law is due to K. F. Gauss, who gave several proofs of its validity, based on more or less reasonable assumptions, one assumption being that positive and negative errors of the same absolute amount have the same probability, another, that the most probable value of a quantity of which a number of direct measurements have been made in the same way is the arithmetic mean of these.

The accompanying figure is a graph of the function $he^{-h^2x^2}/\sqrt{\pi}$, and is called the probability curve, or curve of error.



The area OMPA measures the probability that any error lies between 0 and OM, and the total area between the curve and the x -axis is unity. If M be chosen so that the area OMPA is equal to half the whole area under the curve and to

the right of OA, and therefore $= \frac{1}{2}$, then OM, whose value is then $\frac{1}{2} \cdot 4709/h$, is called the *median error*. It is such that on the whole there will be as many errors greater than the median as there are errors less than it. This result explains why h is called the precision.

When a large number of observations do not form a normal series, i.e. when the distribution of errors is not according to the 'law of error', there is reason to believe that the errors are not merely accidental, and some cause may be looked for. This reasoning has been applied with effect by K. Pearson and others with reference to biometrical observations.

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Probate, in law, the official proof of a will, that is, the proceeding by which it is established as the last will and testament of the party whose will it professes to be. In England this is obtained in the Probate division of the High Court of Justice. The original will is deposited in the registry of the court and a parchment copy given to the executors, with certificate of its having been proved.

Probate, Court of, an English tribunal established by Act of Parliament in 1857, to which all the powers previously exercised by ecclesiastical courts in the granting of probates of wills and letters of administration were transferred. This court was merged in the Supreme Court by the Judicature Act of 1873, by which its jurisdiction was assigned to a Probate, Divorce, and Admiralty Division. The functions of this branch are confined entirely to deciding on the authenticity of wills and upon the proper persons to whom administration is to be committed when no will exists. The practice of the court is thrown open to the whole legal profession, and its proceedings are otherwise assimilated to the courts of common law.

Probate Duty, a tax imposed upon the gross value of the personal property of a person dying prior to 2nd Aug., 1894, and levied by means of a stamp upon the affidavit required of the person applying for probate (q.v.). In respect of deaths on and after that date it was superseded by the new estate duty then introduced. See *Death Duties*.

Proboscidea, a sub-order of hoofed mammals distinguished, as implied by this name, by the possession of the characteristic proboscis

or trunk. Of this sub-order the elephant alone exists; but there are several extinct animals comprised in it, such as the mammoth and the mastodon.

Proboscis, the name given to the longer or shorter flexible muscular organ formed by the elongated nose of several mammals. Although seen in a modified degree in the tapirs, &c., the term is more generally restricted, and applied to indicate the flexible 'trunk' of the elephant. It is also given to the projecting mouth-parts of some insects, e.g. mosquito and butterfly; a protrusible tube at the front end of nemertine worms, the eversible pharynx of planarians, &c.

Proboscis Monkey, or **Kahau** (*Nasalis larvatus*), a native of Borneo, distinguished par-



Proboscis Monkey or Kahau (*Nasalis larvatus*)

ticularly by its elongated nose, its shortened thumbs, and its elongated tail. The general colour is a lightish red. These monkeys are arboreal in habits, and appear to frequent the neighbourhood of streams and rivers, congregating in troops.

Probus, Marcus Aurelius, one of the ablest of the Roman emperors, was born at Sirmium in the year A.D. 232. He entered the army and attracted the notice of the Emperor Valerian, who raised him to the rank of tribune. On the death of the Emperor Tacitus, in 276, the army hailed him as emperor, a selection immediately confirmed by the Senate and people of Rome. His chief struggle during his reign was to guard the frontiers of the empire against the barbarians, a task which he carried out with great success both in Europe, Asia, and Africa.

He also settled large numbers of barbarians in the frontier provinces, and admitted them to his legions; and devoted himself to the making of roads and draining of marshes. His skilful administration and public virtue did not, however, protect him from enmity; and after a short reign he was murdered in a military insurrection in 282.

Proce'dure, Civil, is the method of proceeding in a civil suit throughout its various stages. In England, when redress is sought by law for a civil injury, the injured party brings an *action* against the party whom he alleges to have done the injury. The person who raises an action is termed the *plaintiff*, and he against whom the action is brought, the *defendant*; in Scotland the terms are *pursuer* and *defender*. It is usual before the suit is commenced for the plaintiff's attorney to acquaint the defendant with the demand of his client, and state that unless complied with legal proceedings will be instituted. Should this not have the desired effect, the action is begun as a rule by issuing against the defendant a *writ of summons*, commanding him to enter an *appearance* in court, failing which an appearance will be entered for him by the plaintiff. When an appearance has been entered, both parties to the suit are now said to be *in court*, and judgment may be proceeded with. The next stage is the *pleadings* or the statements in legal form of the cause of action or ground of defence brought forward by the respective sides. The next stage of procedure after the pleadings is the *issue*, which may be either on matter of law or on matter of fact, where the fact alone is disputed. A matter of law is determined by the judges after hearing argument on both sides, but an issue of fact has to be investigated before a jury (unless a jury is dispensed with by consent of parties or, where competent, by order of the court), and this is denominated *trial by jury*. (See *Jury and Jury Trials*.) After the judge has summed up to the jury the *verdict* follows and then the *judgment* of the court; where there is no jury, of course, judgment is pronounced by the judge after hearing counsel.

Procellar'idæ, the petrel family of birds, of which the typical genus is *Procellaria*, which includes not only petrels but also albatrosses, fulmars, and shearwaters.

Process-work is the name given to methods of using photography to produce printing surfaces that will yield an unlimited number of prints of artists' work, photographs, &c. Process-work is sometimes understood as comprising only line and half-tone block-making for typographic printing in monochrome and colour, but other photo-engraving methods, such as photogravure, machine gravure, colotype, and

photo-lithography, are often included under this heading, and will be dealt with here. The essential steps in process-work are founded on the chemical action of light on the silver halides used for making the negative, and on the bichromated colloid employed for obtaining the resist, or greasy image, on metal or paper; the light either rendering the colloid insoluble to a greater or less degree in hot or cold water, or making it less absorbent of water so that it will take a greasy ink applied by a roller.

Line block - making, for relief printing, is a means of reproducing black and white designs, drawings, maps and plans, &c., on zinc or occasionally copper, in a form suitable for printing in a printing-press along with ordinary type-matter. The original for reproduction should be drawn in black opaque ink on white Bristol-board, a special drawing-ink being made for the purpose and known as process ink, of which there are two kinds, fixed and unfixed. The former is prepared for drawing in line over photographs, the silver image of which can be removed by chemical means, leaving the drawing intact. The drawing must be firm and have no broken or weak lines. The size of the original is not very important, but for convenience it should be about one-third larger than the reproduction size. Line blocks are made as follows. The original to be reproduced is fixed on the copy-board of the camera and illuminated by powerful arc lamps, and focused up to the required size on the focusing-screen of the camera. A negative is made, generally by the old wet collodion process or on a special dry plate; this negative must reproduce the original like a stencil, the white portions of the original being shown as opacity and the black design as clear lines. This negative is the means by which the acid resist is obtained on the metal. The metal used is generally zinc, about $\frac{1}{8}$ of an inch thick, which is cleaned with fine pumice-powder and water to remove any tarnish and grease, and then coated with a bichromated albumen, which is a mixture of water, white of egg, and ammonium bichromate. This composition is made to flow over the metal, and then whirled to obtain an even film. When dry the metal is placed under the negative, film to film, and exposed to light under considerable pressure, the light used being either daylight or more often that from an enclosed arc lamp, as these lamps emit a large proportion of the ultra-violet rays to which the bichromated film is very sensitive. The light passes through the clear portion of the negative and renders the film insoluble; the opaque parts of the negative stop the light action, and the albumen remains soluble. After exposure the zinc plate is covered with a thin film of greasy ink by means of an ink-roller, placed in water,

and carefully rubbed with a pad of cotton-wool to help the removal of the soluble parts. After development the drawing is seen in black ink on the metal surface. This ink resist is warmed, dusted with either powdered bitumen or resin to strengthen it still further, and again warmed to incorporate the powder with the ink. Defects having been touched up, the back is painted with shellac varnish: the plate is then ready for the etching-bath. The etching-mordant is nitric acid, which etches away the exposed portions of the zinc, the protected parts remaining in relief. After the first etch, the plate is removed from the etching-bath, washed in water, and dried; then warmed again and dusted either with a resin known as dragon's blood or with bitumen, this being necessary to protect the sides of the parts standing in relief from undercutting by the acid. The etching is repeated until the required depth is obtained. The resist is then removed, and the plate is ready for mounting and proving. The mounting consists of cutting away all surplus metal, and nailing the plate to a piece of hard wood, either mahogany or oak, to make it type high. The block is now ready for the printing-press.

The half-tone process is a relief method of obtaining reproductions of photographs, wash drawings, or coloured originals; in fact any original showing gradation of tone can be reproduced by this process, and the blocks can be used for printing with type-matter. The gradation is reproduced by breaking the original up, when photographing it, into dots of varying sizes. These dots can be seen by inspecting a newspaper or magazine illustration, when it will be observed that the whites and lighter tones of the original are reproduced by small round dots that permit a considerable amount of white paper to show, and the lower tones by larger dots that gradually assume a square shape, thus obscuring a greater area, until in some parts the paper becomes almost uniformly covered with ink and no dots can be seen. The best type of original for reproduction purposes is one made on a glossy bromide of silver paper, or drawn in a warm black and grey. Many originals are specially drawn for reproduction, and considerable skill is required to select the correct colours, as some colours turn out on reproduction much lighter or darker than the originals. Chinese white, e.g., reproduces as a grey, but process white as a white. Blue-blacks reproduce much lighter than they appear, while browns, reds, greens, and yellows come out black, unless the photographer uses special colour sensitive plates, which are too expensive for the ordinary run of process-work. The screens used for photographing through are formed from plates of glass, each of which is ruled with a set of equidistant parallel

lines. Two such plates are cemented together so that their lines are at right angles, thus forming a network of small squares. The closeness of the ruling depends on the class of work. For newspaper work it is 60 to 65 lines per inch, for magazine work 100 to 120 lines per inch, and for catalogue and high-class printing 130 to 200 per inch. The screen is held in a special holder contained in the camera, and adjusted to a calculated distance from the sensitive film. The original is photographed through this ruled screen, and thus appears on the negative as broken up into dots of varying sizes. The metal used for making the block is copper for fine work, and zinc for coarse work such as newspaper or magazine illustrations. The sensitive resist used is a bichromated fish-glue. The metal is prepared and coated as in line-work. After exposure the plate is placed in cold water, which dissolves away the soluble glue, i.e. the portions under the black dots of the negative, while the parts where the light has acted remain and form the resist. This glue image is dried and subjected to considerable heat, which converts the glue image into an acid-resisting enamel. The mordant used for etching copper is perchloride of iron dissolved in water to a strength registering on a Baumé hydrometer 35°. The plate is first rough etched, and then fine etched. Fine etching is carried out by covering the portions that have been etched sufficiently, generally the darker parts of the picture, with an acid resist, and then replacing the plate in the etching-bath until the required result is obtained. The different-sized dots stand out in relief on the finished plate. The metal plate when finished is trimmed up to the right size and bevelled round the edges. Holes are drilled in the bevel to receive the nails that hold it to the wooden support. A smooth surface paper is used for printing fine-screen half-tone blocks. Coarser blocks can be printed on a commoner kind of paper, with loss of gradation. Line blocks may be printed on paper of any quality or surface.

The three-colour process is an extension of the half-tone process, applied to the facsimile reproduction of coloured pictures, &c. In what is known as the *direct process*, the original is photographed through the half-tone screen on three colour-sensitive dry plates. The first negative is taken through a blue filter, the second through a green filter, and the third through a red filter. The plates (which are known as panchromatic) and the colour-filters are very accurately adjusted for the process. The function of the red, green, and blue filters, which are placed in front of the lens, is to absorb any light to which the plates are sensitive other than that required to make the respective records. The three plates are etched as described for half-

tone etching, the etcher requiring to have a good knowledge of colour to obtain correct colour results. The blocks are printed in the colours complementary to the colour-screens used for taking the negatives, the block made from the blue record negative being printed in yellow, that from the green in magenta, and that from the red in blue-green.

In the *indirect method* three continuous tone negatives are made through the three colour-screens, no half-tone screen being used at this stage. From these negatives, positives are made on suitable dry plates, and from these positives, screen negatives. This method is employed when photographing away from the process studio, when it is not possible to use the half-tone screen. Often a fourth printing-plate is used, which is printed in black or grey.

Photogravure is an intaglio method of reproduction; that is, the printing surface is sunk beneath the general surface of the plate. It is one of the oldest branches of photo-engraving. A continuous tone negative is made of the original, and from this a positive is obtained either by the carbon process on glass, described later, or on an ordinary dry plate. The polished copper plate is cleaned and grained. The grain is deposited on the copper by shaking up finely powdered bitumen or resin in a specially constructed box known as a 'dusting-box', and allowing it to settle on the copper. The dust is fixed to the plate by heat, and acts as a resist to the etching-mordant. Small points are formed over the plate, and act as a mesh to entangle the ink when printing on paper. Between the points the depth of the etching varies in proportion to the gradation of tone shown on the original. To obtain the resist a print is made from the positive on a bichromated gelatine film containing a finely ground pigment, and held on a paper support; such a film is known as a carbon print. It is by this process that the original positive also can be made. After exposure to light the bichromated film is soaked in cold water, laid face downwards in contact with the grained surface of the copper plate, and put aside for a short time before developing. The plate is immersed in hot water, when the paper support can be pulled away, leaving the film adhering to the plate. After the removal of the paper the water is heated and dissolves away the gelatine that has been more or less unaffected by light, as in the lighter tones. After development the highest lights of the original picture are represented by the greatest thickness of gelatine, the half-tones by intermediate thickness, and the shadows by a thin skin. When dry, the back and sides of the plate are protected with an acid-resisting var-

nish, and it is then ready for etching. The etching-fluids consist of varying strengths of perchloride of iron. The gelatine film resists the mordant in proportion to its thickness; the thinner the resist the greater the depth of etching. The dark tones of the original are etched in a strong solution of perchloride of iron, and the lighter tones in a weaker; considerable skill is necessary to know when to transfer the plate being etched from one bath to another so as to retain correct gradation. The resist is now removed and the plate carefully cleaned, the edges being rounded to prevent them cutting the paper when printing, and also to give the plate-mark characteristic of most intaglio methods. To protect the delicate surface of the plate it is given an electrolytic deposit of iron. Photogravure plates are proved by hand, such proving being a trade by itself. To obtain proofs the plate is warmed, ink is forced into the hollows by means of a pad of coarse canvas, the surface ink is wiped away, and the margins carefully cleaned. Damped paper is placed on the plate, backed with soft blanketing, and then passed through a copper plate press, somewhat like a household mangle, but fitted with steel rollers instead of wooden ones. The proving requires artistic skill to obtain the best results from the plate. Photogravure is extensively employed for making copies of famous works of art, an application for which it is eminently suited.

Machine gravure is somewhat like photogravure, but the working is more mechanical. The grain is replaced by a network of lines crossing each other and forming minute squares. This process has important commercial applications—for the production of illustrations in magazines, catalogues, and newspapers. The type-matter can be etched on the same metal as the illustrations, the printing being done in specially constructed power-driven presses. The working details are almost the same as in the process just described, except that the network of lines is obtained by printing from a cross-line screen with transparent lines on the bichromated film, the picture positive being printed over the screen. The exposed films are transferred to a copper cylinder (which may weigh 2 cwt.) together with any type-matter, the etching being carried out as for photogravure. For printing, the cylinder is fixed on the press and inked from below with a spirit ink applied by means of a roller revolving in an ink-duct, the surface ink being removed by a steel blade (known as a doctor), which passes horizontally across the revolving cylinder. The paper is drawn between two cylinders, one of which is the printing cylinder, the other supplying the pressure; this pressure causes the ink to be

drawn out of the printing depths and deposited on the paper.

Photo-lithography is a photographic method of obtaining the greasy image on lithographic stone or metal (see *Lithography*). This greasy image can be printed from a line or half-tone negative by the method which is used for making line blocks; no etching, however, is necessary. The metal used is a thin sheet of zinc or aluminium that has been grained in a special machine to make the surface receptive of water. After the plate has been exposed and developed, it is dried and covered with a thin coating of gum, when it is ready for printing in the press. Another means of obtaining the greasy image is to print the negative upon a paper coated with bichromated gelatine, which after exposure to light is rolled up with a special transfer ink, and then developed in water, the exposed parts retaining the ink. This ink image can be transferred to metal or stone.

These metal plates are now mostly printed by the *rubber offset press*. The metal plate is tightly drawn round a steel roller that revolves against another cylinder round which is stretched a rubber sheet. Each revolution of the cylinders leaves an offset of the ink on the rubber sheet, from which it is transferred to the printing-paper. Offset is the latest method of reproduction, and it would appear that there is a big future for the process, which will print half-tones on almost any surface of paper, however rough. Tin printing has been done for many years by offset.

Collotype is a surface-printing process somewhat akin to lithography (q.v.), the action of light replacing the handwork of the artist, and gelatine, from which impressions are taken in a greasy ink, replacing the stone. Gelatine has an open cellular structure, and can absorb water. On the addition of ammonium bichromate to the gelatine and subsequent exposure to light, the gelatine cells harden in proportion to the light action, which is controlled by the densities of the negative; the weaker the light action, the greater the absorption of water. A collotype plate after exposure represents the original in a selective reticulated grain; the closer the grain, the greater the amount of ink deposited. The printing-plate is prepared by coating thick sheets of glass with a hot solution of bichromated gelatine, which is then dried by heat in a special oven, and when dry is exposed to light under the negative. After exposure the film is well washed in running water to free the gelatine from the bichromate salts, and again dried in the air. To prepare for proving, the plate is soaked in water, and after soaking is treated with a mixture of water, glycerine, and ammonia, which after a time is dabbed off, when the plate is ready for proving. The proving is

done in a special press somewhat like a litho. press, the pressure being applied by the action of a scraper under which the plate and paper are passed; these presses are either power- or hand-driven.

This process is also used for obtaining the key, or foundation printing, in *chromo-lithography* (q.v.). By varying the proportion of the sensitizer, and by the addition of calcium chloride and potassium ferricyanide to the gelatine, the grain is somewhat enlarged, and it is possible to pull proofs from the plate on special transfer paper; these transfers are then transferred to stone or metal, and thus save a considerable amount of hand work. This process produces results of a very smooth quality, and is used for the reproduction of old documents and illuminated manuscripts, pastel, crayon, pencil sketches, and coloured originals. It also affords a means of imitating at a cheap rate photographic prints, many picture post cards being produced by collotype. The process is not much worked in England on account of the uncertain climate, its successful working being dependent on an even temperature and constant climatic conditions.—BIBLIOGRAPHY: S. H. Horgan, *Photo-engraving Primer*; W. Gamble, *Line Engraving*; T. W. Lascelles, *Engraving*; H. O. Klein, *Three-colour Photography*.

Procida (pro'chi-dá; ancient *Prochyta*), an island on the west coast of Southern Italy, lying nearly midway between the Island of Ischia and the coast of the province of Naples. It is about 3 miles long and 1 mile broad, of volcanic origin, flat in surface, and of comparatively irregular coast-line. The principal town is Procida, or Castello di Procida, which has a harbour, a castle, and a royal palace. Tunny and sardines are caught in adjacent waters. Pop. (town), 4600.

Proclamation, Royal, a public notice made by the sovereign of a country to his subjects, concerning any matter which he thinks fit to give notice about. Proclamations consist of an authoritative announcement of some great event affecting the state, and are issued on the accession of a new sovereign or on the declaration of war. In normal times proclamations are issued in this country for the summoning, prorogation, and dissolution of Parliament. A royal proclamation must be issued under the Great Seal. By statute, royal proclamations are only binding when they do not contradict existing laws or tend to establish new ones.

Proclus, a Neo-Platonist, born at Byzantium in A.D. 412, died at Athens in 485. He was educated at Alexandria and Athens, and became familiar with all branches of philosophy and theology. His system aimed at the widest comprehensiveness. He not only endeavoured to unite all philosophical schemes, but made it a maxim

that a philosopher should embrace also all religions by becoming infused with their spirit. In his writings he professes to return to Plato, and to bring down Neoplatonism from the misty heights to which it was raised by Plotinus. He was a violent opponent of Christianity, and composed hymns in honour of the pagan deities of Greece. His extant works include a *Sketch of Astronomy*, in which he gave a short view of the systems of Hipparchus, Aristarchus, and Ptolemy; *The Theology of Plato*; *Principles of Theology*; and a *Life of Homer*.

Proconsul and Propraetor, in the Roman system of administration, a consul or praetor whose command (or *imperium*) was prolonged for a particular purpose after his demission of office. In course of time the terms came to be applied to any one who was entrusted with some special service, and with magisterial authority for the purpose of performing it. Proconsuls and propaetors were generally men who had been consuls or praetors, but were not always so. There were four varieties of proconsul: (1) A distinguished statesman, formerly consul, appointed for a special duty. (2) An individual, who had never been consul, was sometimes created proconsul to be sent on some important mission. (3) A consul occasionally had his *imperium* prolonged, in order to complete some undertaking he had commenced. (4) A consul appointed after his term of office to the government of a province. The proconsuls under the Republic had no authority within the walls of Rome, and they lost their *imperium* on entering the city. Under the Empire the emperor was always invested with proconsular authority.

Procopius of Caesarea, a Byzantine historian, a native of Caesarea, in Palestine, where he is supposed to have been born about A.D. 500. He first attracted the notice of Belisarius, who appointed him his secretary; and about the year 541 he was appointed by the Emperor Justinian a senator and afterwards (562) prefect of the city. He died at Constantinople about A.D. 565. His works are a *History of his Own Times* and a history of the edifices built or repaired by Justinian. A scandalous chronicle of the court of Justinian, entitled *Anecdota*, has also been attributed to him by some writers. Many interesting passages from this work figure as foot-notes to Gibbon's *Decline and Fall*.

Procrustes ('the Stretcher'), the surname of a robber of ancient Greek legend named Polypemon, or Damastes. He had two beds, one short and the other long, and boasted that they would fit everybody. If his victims were too short for the bed, he stretched them to death, while if they were too tall, he cut off their feet or legs. Theseus served him in the same way.

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Procter, Bryan Waller, British poet and prose writer, born at Leeds 1787, died in London 1874. He was educated at Harrow, where he was the school-fellow of Byron and Peel. His first published work was entitled *Dramatic Scenes and other Poems*, and appeared in 1819 under the pseudonym of Barry Cornwall, which remained Procter's pseudonym in his future writings. This volume being well received, he published shortly thereafter *A Sicilian Story* and *Marcian Colonna*. In 1821 he produced a tragedy, *Mirandola*, which was performed with great success at Covent Garden. Procter also wrote several other books of poetry and a variety of prose works, the most interesting of these latter being a *Memoir of Charles Lamb*, of whom he was an intimate personal friend. Procter's poems exhibit much delicate grace and refinement, but have never attained great popularity. He was called to the Bar in 1831, and for many years held the post of a commissioner in lunacy, which, however, he resigned in 1860.

Proctor, Richard Anthony, British astronomer, born at Chelsea in 1837, died in New York in 1888. Educated at King's College, London, and Cambridge University, he devoted himself specially to the study of astronomy. In 1881 he founded a scientific journal called *Knowledge*, which for some years had a considerable circulation. His works include: *Saturn and its System*, *Handbook of the Stars*, *Half Hours with the Telescope*, *Half Hours with the Stars*, *Other Worlds than Ours* (a very popular work), *Light Science for Leisure Hours*, *The Transits of Venus*, *The Cycloid and Cycloid Curves*, several *Star Atlases*, *The Universe of Stars*, *The Moon*, and *The Poetry of Astronomy*.

Proctor (from the Lat. *procurator*), one who acts for another. The name was formerly applied to a person who in the ecclesiastical and admiralty courts in England performed the duties of an attorney or solicitor. The proctors were formerly a distinct body, but any solicitor may now practice in these courts. The king's proctor is a Crown official charged with the duty of conserving the public interests in certain classes of private lawsuits. He intervenes in actions of divorce and nullity of marriage if he has reason to suspect collusion or fraud. In the Universities of Oxford and Cambridge the proctors are two officers chosen from among the masters of arts, whose office is to preserve discipline.

Proc'urator, among the ancient Romans, a provincial officer who managed the revenue of his province. In some of the small provinces, or in a part of a large province, the procurator discharged the office of a governor, and had the power of punishing capitally, as was the case with Pontius Pilate in Judea, which was attached to the province of Syria.

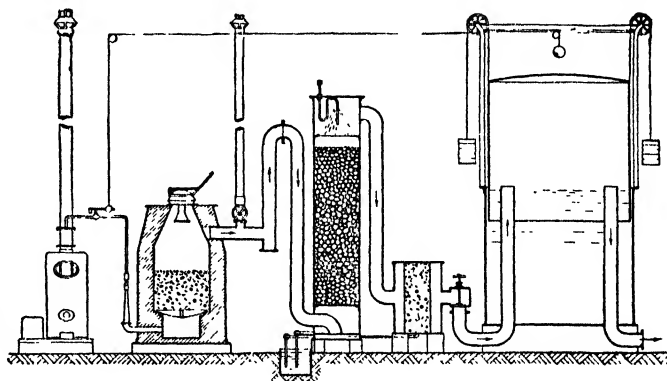
Procurator-fiscal, in Scotland, an officer appointed to act as the public prosecutor in criminal cases before the sheriff, magistrates, or justices of the peace belonging to his district. He is allowed to practise privately as a lawyer also. When information of a crime committed within a procurator-fiscal's district has been laid before him, it is his business to ascertain the truth of the charge, to obtain a warrant for the apprehension of the accused, to see that the warrant is carried out, and in general to do whatever else is necessary to protect the innocent, and bring the guilty to justice. All precognitions of witnesses are taken by him before the sheriff or sheriff-substitute of the district. The procurator-fiscal has also, in conjunction with the sheriff, to discharge the duties of a coroner in making investigations with regard to persons who are suspected to have died from other than natural causes.

Producer-gas, the name given to that mixture of gases which is obtained when air or steam or the combination of both in various proportions is passed through a column of broken fuel which has been raised to incandescence. The combustion processes which take place are used to provide the heat required to raise the temperature of new supplies of fuel. When air comes into contact with the hot coke, anthracite, bituminous coal, wood-chips, sawdust, or whatever combustible material is used, complete combustion takes place and the carbon of the fuel is burned to form carbon dioxide. This gas in its progress up through the thick bed of fuel unites with more carbon and forms carbon monoxide. When the steam strikes the incandescent mass it is decomposed, and the hydrogen which is released passes out from the producer with the other gases. In composition producer-gas varies widely because of the different proportions of air and steam used in its preparation, but the gas contains all the carbon of the fuel in the form of carbon monoxide or dioxide. Other gases present are hydrogen, methane, and nitrogen. The proportion of carbon monoxide can be increased and of dioxide diminished by increasing the depth of the bed of fuel. One factor of considerable importance in the improvement of the efficiency of a gas producer is the manner in which the waste heat from the generator and gas-pipes is utilized to pre-heat the air and generate the steam which are used in the process. The efficiency of a gas producer is very

high, despite the fact that all the carbon of the fuel does not pass out in a combustible form. That part of the carbon which passes away as carbon dioxide has already given up its heat to serve the useful purpose of keeping up the temperature of the bed of fuel. After passing from the generator the gas is washed to remove objectionable materials before it is led away for use. In some types of producers, such as the Mond plant, by-products are recovered from the gases.

Gas producers may be divided into groups according to the manner in which the steam and air are sent through the fuel, and also according to the type of fuel used, whether bituminous or not.

Pressure Producers.—In this type of plant the air is drawn into the producer by a stream of



Dowson Pressure Producer

steam issuing from a jet. The steam is generated in a separate boiler, and is passed under pressure to the nozzle. The calorific value of this gas is about 130 to 150 British Thermal Units per cubic foot. The quality of the gas can be kept the same throughout the whole period of working. The gas is led away to a gasometer, where it is stored. It is usually arranged that the fall in the gasometer is used to operate the steam-valve to restart the generator. The steam-boiler, producer, scrubber, drier filled with sawdust, and gasometer are shown in order in the illustration of a Dowson type of plant. An objection to this type of plant is that the producer is under pressure, and leaking joints may be the cause of considerable escapes of the gas, which contains a large proportion of carbon monoxide, a very poisonous substance.

Suction Gas Producers are generally supplied with fuel of the non-caking type, such as anthracite and coke, separate or mixed. The air and steam are, in this type of plant, drawn through the fuel bed by the suction produced on the first

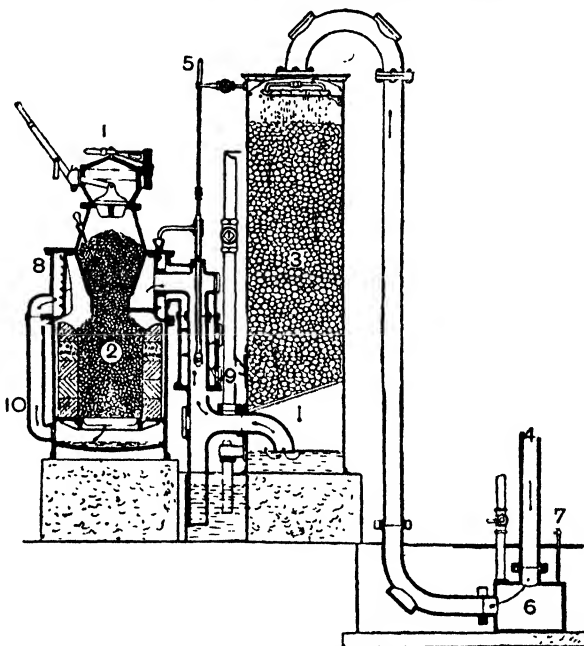
stroke of the gas-engine cycle. The reactions take place momentarily, with time intervals between them, depending on the demands for gas by the engine. When the engine is governed by a 'hit-and-miss' type of gear (see *Internal-combustion Engine*), the demands for gas occur at irregular intervals. If the engine has been running light for some time and full load is suddenly applied, the fuel may have cooled down to a temperature too low to produce a gas of sufficient calorific value, and the engine may shut down.

Such actions were common in the early days of development of this type of plant, but are not so common now when plants have been so much improved in design. The illustration shows a National suction gas producer in section. The fuel is introduced through the hopper, which is provided with a cover as well as a rising and falling base plate. By the use of this hopper there is very little escape of gas into the atmosphere during the charging operation. Full advantage is taken of waste heat for the production of steam and raising the temperature of the air before it enters the generator. The gas is washed free from dust in the scrubber, where it meets with water falling through coke. The gas after washing is passed through an expansion-box before passing to the engine. The producer is started by means of burning wood, shavings, or oily rags, and the gas is drawn off through a by-pass pipe by means of a fan. The producer is then closed up and coke or anthracite introduced through the hopper. A test-cock is provided at which the combustible properties of the gas may be tested by the application of a light. When a combustible gas is produced, the by-pass pipe is closed off and the gas-engine started.

A good suction gas producer uses $\frac{3}{4}$ lb. to 1 lb. of anthracite or 1 lb. to $1\frac{1}{2}$ lb. of coke per brake horse-power hour, the lowest figures being obtained with the largest plants. A general average composition of suction gas is: hydrogen, 15.5 per cent; methane, 1.2 per cent; carbon monoxide, 20.0 per cent; carbon dioxide, 7.0 per cent; oxygen, 0.5 per cent; and the remainder is nitrogen. The calorific value is about 125 to 135 British Thermal Units per cubic foot. Much experimental work has been done in connection with the application of suction gas plants to motor-boats and motor-cars, and their use in such work should show a considerable increase in the future.

Bituminous-fuel Gas Producers.—This forms a

most important division of gas producers in which the cheap bituminous fuels can be used for gas generation. The difficulty experienced in designing plant of this type is to make provision for the elimination of the tar. In the suction type of plant the difficulties have been very considerable but have been largely overcome. One method of dealing with the tar is to destroy it by keeping the fuel at a very high temperature; another solution is to take away the gas from the



National Suction Gas Producer

1, Hopper. 2, Fuel. 3, Scrubber. 4, To gas engine. 5, Water supply. 6, Expansion-box. 7, Test-cock. 8, Vaporizer. 9, Air inlet. 10, Air and steam.

generator at some part of the fuel bed where the temperature is high and thus where the presence of tar is unlikely. In this type of producer it is common to introduce the air and steam both above and below the fuel bed. The fuel consumption is about $1\frac{1}{2}$ lb. of coal per brake horse-power hour.

Mond Gas Plant was designed to make possible the recovery of the nitrogen content of the fuel as ammonia. For the achievement of this purpose a large excess of steam is passed through the fuel, and has the effect of keeping the temperature low enough to prevent the decomposition of the ammonia. The gas is washed with water to make it free from tar, and is passed to lead-lined towers, where ammonium sulphate solutions with an excess of sulphuric acid are used to remove the ammonia from the gas. With

very large plants using fuels rich in nitrogen the gas may be obtained practically free, owing to the large sums obtained for the ammonium sulphate. It has been demonstrated that gas of a calorific value of 135 to 150 British Thermal Units per cubic foot can be produced at a cost as low as twopence to threepence per 1000 cubic feet with even small plants. The equivalent heat contents would be obtained from a city supply at sevenpence threefarthings to elevenpence halfpenny per 1000 cubic feet. In many industrial districts Mond gas is produced in large stations and distributed to the local works through street mains.

BIBLIOGRAPHY: J. E. Dowson and A. T. Larter, *Producer Gas*; V. B. Lewes, *Liquid and Gaseous Fuel*; H. E. Wimperis, *The Internal Combustion Engine*.

Production, Cost of. Economists draw an important distinction between the *money* cost of production and the *real* cost of production. The former is the factor on which the conditions of supply chiefly depend, and is the only cost of production of which the business man takes account. For the production of any commodity certain quantities of labour, capital, and land, or raw material, are required; these are called the agents of production. Each of these agents costs something, and the cost of production of any commodity consists of the sum of the prices that have to be paid to the agents in order to produce it. No one will produce an article if he knows beforehand that its cost of production will be greater than the price for which he can sell it. On the other hand, if the cost of production of anything is very much lower than its market price, many people will rush to produce that thing, in order to pocket a substantial profit, and this will go on until the increased supply has caused the price to fall. The price of any commodity tends, therefore, to equal its marginal cost of production as measured in terms of money. There are, however, exceptional cases in which this relation is modified. Wool and mutton, for instance, are *joint products*; neither can be produced without the other, and we cannot say that a rise in the price of wool will cause an increase in the supply, unless we know what is happening to the price of mutton. In these cases, it is only true to say that the sum of the prices of joint products will tend to equal the sum of their costs of production.

The *real* cost of production of any commodity consists of the efforts and sacrifices involved in making it. The relation, however, between these efforts and sacrifices and the money costs of production is very difficult to determine. The wages of labour, in general, cannot be expected to vary directly with changes in the mental or physical strain involved in work; nor the rate

of interest to vary directly with the sacrifice involved in saving. The real cost of production which the price of a commodity measures is not absolute, but comparative. The prices of the factors of production tend to equal the prices which they could have secured in producing other commodities. It is thus the sacrifice involved in doing without other commodities that is measured by the money costs of a commodity at the margin of production.

Professions, and How to Enter Them. Parents who decide to place their sons and daughters in one of the learned professions must, under modern conditions, be prepared to keep their children at school till the age of at least sixteen or seventeen. While at school the boy or girl should be entered for such examinations as the Oxford and Cambridge school examinations, or the leaving-certificate examinations of the Scottish Education Department, or the examinations of the Board of Education in Ireland. Success in these examinations is not only a test of general ability, but paves the way for entrance into practically every profession. In all professions there is now a preliminary examination, and the certificates procured at school generally exempt from this examination. The easiest way of determining the exact requirements for entrance is to write to the university or other institution to which it is proposed to send the pupil, asking for details and dates of their entrance examinations.

The Church.—It need hardly be emphasized that the taking of holy orders is a supreme step in a man's life, whereby he dedicates himself not to a career but to a vocation. Intensity of conviction and religious fervour will naturally play a large part in the choice, but physical fitness and suitability must not be neglected. In all the larger denominations the necessity of a good university education is increasingly stressed, and while it is not absolutely essential to possess a degree, it is highly desirable. For most of the greater denominations about six years' study is necessary, roughly three years in an arts faculty and three in divinity. The cost varies, but outside of Oxford and Cambridge the fees would amount to about £20 per session. In some of the smaller denominations there is exacted a standard of education not quite so severe as that demanded by a university degree. Many of the Churches are liberally endowed in respect of bursaries for students, and by this means substantial help is given towards the cost of living.

The Law: (1) *The Barrister.*—It may be safely asserted that in no profession does native ability count for so much. The prizes are great, and the disappointments are many. Quickness

of brain, alertness to seize upon points, a wide general culture coupled with considerable intensity of knowledge, are great factors in success. In England and Wales the method of admission to the Bar is as follows: Every applicant procures first from the Inns of Court (The Inner Temple, The Middle Temple, Lincoln's Inn, Gray's Inn) a form of admission. He must have passed a preliminary examination as mentioned above. On admission, he pays stamp duties and fees amounting to roughly £40. His next step is to 'keep' twelve terms (four terms per annum) by dining in Hall six nights in each term. He must further pay a deposit of £100 (£50 at Lincoln's Inn or Gray's Inn) unless he has resided for two years at a recognized university or is a member of the Scottish or Irish Bar. Meanwhile, he is 'reading for the Bar', i.e. for the examination for call to the Bar, which is in two parts. On actual call he must reckon on a payment in stamp duties and fees of about £100. Applicants for the English Bar should write to the Director of Legal Studies, Lincoln's Inn.

In Scotland practically all intending aspirants take a degree in arts and a B.L. or an LL.B at a Scottish university. They are then absolved from the examinations in (1) general knowledge and (2) legal knowledge. Having satisfied the Faculty of Advocates in these two branches, and having propounded and defended a thesis, the candidate is admitted or rejected by a ballot of members of the faculty. Fees for admission amount to nearly £500. Full information is to be had from the Clerk of Intraunts, Advocates' Library, Edinburgh.

In Ireland every candidate for admission to the Bar must obtain a 'memorial' from a practising barrister of not less than six years' standing. This 'memorial' testifies that the candidate is a fit and proper person for admission. In addition to the preliminary examination, he must attend lectures for three years, i.e. one year at Trinity College, Dublin, and two years in King's Inns. Fees in all amount to about £200.

(2) *The Solicitor*.—Admission to practise in England and Wales is conferred by the Master of the Rolls through the Law Society. In addition to the preliminary, there is an intermediate and a final examination, undertaken while the student is serving under articles with a firm of solicitors. (The stamp duty for articles is £80, and a premium which may amount to £100 or upwards.) The term of service is five years, which is reduced in the cases of university graduates to three years. Fees for examination and for final admission to the Roll of Solicitors amount to about £70.

In Scotland the function of solicitor is dis-

charged by a writer to the signet (W.S.), a solicitor to the supreme courts (S.S.C.), or by a law agent. For information on law agents' examinations application should be made to the Clerk to the Examiners of Law Agents, 8 Albany Street, Edinburgh. It should be noted that the W.S. Society, Edinburgh, holds its own examinations. The examinations follow closely those of the English systems, and the period of indenture is the same as for England. Fees for admission run from £60 to £100.

In Ireland the right to practise is conferred by the Irish Incorporated Law Society, whose requirements are similar to those in force in England and Scotland.

Medicine.—Entrance to the medical profession is controlled by the General Council of Medical Education. The duty of this body is to keep a register of qualified medical men and women, to maintain and control the educational standards and curricula, to act as a disciplinary body for the profession, and to publish the *British Pharmacopæia*. Students of medicine register with this body at an age not less than seventeen. Prior to registration they are required to have passed a 'matriculation' examination in general education, and in addition an examination in elementary chemistry and physics at a university, or by a licensing body recognized by the General Medical Council. After registration the course of study extends to a period of at least five years at a recognized medical school. In most instances the whole professional training is undertaken at a university and at the hospitals in the city where the university is situated. In some cases part of the training only is provided at the medical school, clinical study having to be prosecuted elsewhere. It is difficult to state generally the fees payable for a full medical course in varying centres, but £250 for the full course would be a moderate estimate. On graduating, the young doctor is required to register as a medical practitioner under the General Medical Council, and becomes subject to its regulations.

Dentistry is a good example of a profession which, within recent years, has made enormous progress in status, efficiency, and professional standards. The preliminary examinations for registration are now the same as for medicine, and every student must register with the General Medical Council. The intending dentist, to procure the licence in dental surgery, may pass an apprenticeship under a qualified dental surgeon (involving a premium of £50 and upwards), and study for two or more years at a recognized dental school. He may preferably take the whole course at the dental school. He takes his first professional examination at the end of two years, and his final examination at the

close of his course in the dental school. The fees for these courses may be estimated at from £100 to £150.

Teaching Profession.—The profession of teaching is now much more attractive than it was before the European War, the experiences gained in which taught the community the necessity of having a well-educated nation.

The highest branch of teaching exists in the universities, for which distinctive academic success is necessary. Aspirants for academic work must look forward to a period of at least five years' study.

The aim of all educational bodies is to secure that as large as possible a number of teachers shall have received a university education. Courses are arranged between the universities and the training-centres for teachers, by which it is possible to study for a university degree and at the same time take professional training. For elementary teaching it is not essential to possess a degree, and the whole period of study (two years at least) is concentrated upon work at a training-centre. County councils and education authorities make generous provision in scholarships for the intending teacher, and the fees payable for the courses of instruction do not, as a rule, exceed £10 per session.

For secondary teaching the possession of a good honours degree in arts or science or its equivalent is essential. Here it is best to concentrate wholly on university work, generally for at least three years, and subsequently to spend a year on purely professional training. Fees for the university courses should, except in the cases of Oxford and Cambridge, be reckoned at from 20 to 30 guineas per session.

Recognition of the successful completion of training is made by the Boards of Education in England and Ireland and by the Education Department in Scotland by the issue of certificates, whereupon the teacher is qualified as a 'trained certificated teacher'.

For teaching in the public schools professional training is not absolutely necessary. Here the prospects are somewhat uneven, much depending on the standing of the school. The work of a residential master in a large public school is of an onerous nature, and none should undertake it who are not genuinely fond of boys, or who are unprepared to enter into all the varying activities of school-life.

The Civil Services.—In the Higher Civil Services a good honours degree is necessary. Posts in the Home Civil Service, the Indian Civil Service, Eastern Cadetships, and the Consular and Diplomatic Services are gained as a result of competitive examinations of great severity. For these wide general knowledge in addition to intensity in a few subjects must be obtained.

In the various branches of the Civil Service for which the same standard of knowledge is not requisite, the competition is equally great. Candidates for the above services and for second-division clerkships, income-tax surveyorships, and posts of a like nature should apply to the Secretary, Civil Service Commission, Burlington Gardens, London. Notification of examinations is made in the public press. For success in these examinations it is necessary to have specialized coaching, provision for which is made in practically all the larger centres at a moderate cost.

The rates of pay in the various branches of the Civil Service while not high, are nevertheless fairly attractive. In the ordinary way the salary rises automatically to a settled maximum; seniority, however, is not the only element in promotion, and inefficiency may debar an automatic increment.

For those desirous of serving under the British Government in overseas territories, application should be made to the Appointments Secretary, The Colonial Office, London, who will supply a booklet giving full details of possible situations. See *Civil Service*; *Indian Civil Service*.

Engineering and Allied Professions.—It is difficult to advise a young man about the best way of entering the engineering profession unless one knows all the circumstances of his education, aptitudes, and his possible associations with engineering concerns. No hard-and-fast rule regarding any part of his training can be laid down, and he would be well advised to consult members of his family or friends who are in the profession before taking any decisive step. Theoretical training of a fairly high standard must be obtained as well as a thorough knowledge of workshop processes if success is to be attained. The order in which the training should be obtained has always been the subject of controversy, but the embryo engineer should arrange for his entry to an engineering works before he starts his classes. It is perhaps the best thing to take the classes requisite for the intermediate examination for his bachelor of science degree or his diploma before he actually starts his practical work. There are many engineering schools of first rank in the country, among which the leading ones are the Imperial College of Science and Technology in London, the University of Cambridge, the Municipal College of Technology and the Owens College of the Victoria University of Manchester, the University of Glasgow, and the Royal Technical College, Glasgow. After a year or two at the works he should return to his college classes and complete his degree course, and then return to the works. Every young engineer should qualify for admission to one or more of the engineering institutes at

the earliest possible time. Glasgow and Edinburgh Universities and the technical colleges associated with them hold their classes during the winter six-months, so that students can obtain their works and theoretical training on the 'sandwich' system. Advice as to the types of works to enter can only be given by those who have a knowledge of the future intentions of the young engineer, who will have to specialize in some part of the enormous field covered by the term engineering.

Agriculture.—Entry to the professions connected with agriculture may be obtained in a variety of ways. There are two main branches—agriculture and dairying—and a practical knowledge of both is advisable although not absolutely essential. University degrees in agriculture, B.Sc. (Agric.), are obtainable in most centres, but there are two diplomas, viz. the National Diploma in Agriculture (N.D.A.) and the National Diploma in Dairying (N.D.D.), which are frequently of more worth. Honours may be taken in the diploma examinations, which, in the case of the N.D.A., are held at Leeds, and at Kilmarnock (Dairy School for Scotland) and Reading for the N.D.D. The N.D.A. and N.D.D. are useful for prospective farm managers, creamery and milk-depot managers, factors, &c. Preliminary farm experience may usually be obtained by residence on a farm or by travelling as a milk-tester, and the college course may be taken during the winter season, and the practical farm-work in summer. In dairying, however, a practical course at a recognized institution is essential, and for admission to this course there is generally a milking examination. The N.D.D. examinations at Kilmarnock, for instance, comprise the making of hard and soft cheeses and butter, as well as written and oral questions in dairying, general farming, veterinary science, bacteriology, chemistry, &c. **Forestry** courses are akin to those in agriculture, and may be taken at any good agricultural college. In **veterinary science** no licence is required to practise, but the holding of the diploma of the Royal College of Veterinary Surgeons (10 Red Lion Square, London, W.C.1) is of highest importance. **Pharmacy**—a profession of recognized value—demands, in addition to an apprenticeship with a chemist or druggist, the passing of a minor and later a major examination. For information on the standard involved in these examinations, the candidate should consult the Registrar of the Royal Pharmaceutical Society, Bloomsbury Square, London, W.C.1. **Chartered Accountancy** offers attractive prospects. Examinations are held by the Institute of Chartered Accountants (Moorgate Place, London, E.C.) in England, and by the three Scottish Societies of Chartered Accountants in Edinburgh, Glasgow, and Aber-

deen. There are, in addition to the preliminary, two examinations, intermediate and final, which are taken during the period of articulated service (five years in the case of a non-graduate, three in the case of a graduate). In most centres a premium is payable (£50 to £100) when a pupil is articulated, though in certain of the centres no premium is exacted.

See also the articles *Army*; *Navy*; *Shipping*; *Journalism*.

Professor, the title given to salaried teachers in universities and similar institutions who are appointed to deliver lectures for the instruction of students in some particular branch of learning. Professor was the name given in the time of the Roman emperors to public teachers appointed, with fixed salaries, in Rome and others of the more important cities of the empire. The name, taken from the Latin verb *profiteri*, denoted that they publicly made themselves known as engaged in the pursuit of their particular art, and in the business of teaching it. In Oxford and Cambridge the professors devote themselves mainly to the advancement of learning; the preparation of undergraduates for examinations is undertaken by the college lecturers. In the universities of Scotland and Germany, on the other hand, the professors are at once the governing body and the chief recognized functionaries for the purposes of imparting instruction.

Profit. In ordinary language profit denotes the net gains of any business organization, whether joint-stock or in private hands, after meeting what are usually reckoned as costs of production. This use of the word includes interest on capital owned by the business man and invested in his business, together with wages for managerial or professional work exerted by him in it. After deduction of these there remain the earnings of business enterprise itself. In the language of economics the term profit is restricted to this form of income.

The function of the business man or entrepreneur is to initiate economic activity, to hire and combine the other factors of production (land, capital, various forms of labour), and to venture them into prospectively profitable openings. Through competition and the decisions of entrepreneurs regarding the amounts of the other factors of production that it is worth while employing, the remuneration of these factors continually approximates to their net contribution to the joint output. It is rather more difficult to see that this can be so with the entrepreneur's own earnings; indeed, Ricardo and his followers regarded profit as an unearned increment. But the entrepreneur will not exercise his function without return, and, given free competition, a business man's profits will tend

not to exceed what similar abilities and efforts could command in other callings. To the extent that exclusive educational advantages, limitation of business opportunity to owners of capital, and combinations among business men occur in the economic world, profit includes an element of monopoly revenue, which is responsible for the stigma cast upon it by the popular derivative 'profiteering'. Were it not for these exceptions, competition among business men and between the different openings presenting themselves in the choice of a career would secure the approximation of profits to the entrepreneur's net contribution to the total product of industry.

Profit-sharing, or copartnership, is the name applied to schemes whereby a business firm associates its employees with its own financial interests. In addition to paying the usual rate of wages, it agrees to distribute among them a certain proportion of any profits made above a fixed minimum. Sometimes, instead of distributing cash, a special class of shares is issued. The amount that accrues to each employee depends on his rate of wages, and often on his length of service. Participation is sometimes voluntary. Usually the firm retains complete control of its business, but some schemes provide for workmen-directors elected by the participating employees.

The ideas underlying profit-sharing are: (1) that the workman's strength and skill are just as much invested in the business as the shareholder's capital, and therefore they should be capitalized and a dividend paid in respect of them; (2) that the knowledge that they participate in the fortunes of the firm gives an additional incentive to the workers and increases efficiency, so as to provide higher profits for shareholders even after payment of the workers' share; (3) that a sense of unity between management and employees reduces losses due to disputes; this is especially so in schemes under which a man who leaves the firm without permission forfeits accumulated dividends.

With a few exceptions, profit-sharing has not worked well in practice. The chief reasons are: (1) the system is difficult for a single firm to work, and it has never yet been applied to a whole industry; (2) the increase in efficiency referred to above is rarely attained in practice; (3) it cannot stand a falling market or considerable fluctuations of profits; (4) it is unpopular with organized labour, because (a) it interferes with the mobility of labour between different firms, (b) it yields too small an increase in pay (5 to 6 per cent on the average) to balance its disadvantages, (c) it substitutes dependence on the employer for trade-union solidarity, and makes collective bargaining difficult, particularly where it penalizes strikes.

The businesses in which profit-sharing has proved successful over a long period (Lever Brothers, and the Gas, Light, and Coke Company are notable instances) have usually been in possession of a monopoly, or engaged in the production of something for which there is a steady demand. A gas company fulfils both these conditions, and, in addition, the sliding scale between profits and price of product helps to stabilize the former; virtually profits are shared between the workers, the shareholders, and the consumers.—**BIBLIOGRAPHY:** Gilman, *A Dividend to Labour* (Report of the Board of Trade on Copartnership, Cmd. 544); S. Webb, *Industrial Democracy* (chapter xii); G. D. H. Cole, *Payment of Wages* (chapter xiii).

Progression, in algebra, a series of numbers succeeding each other according to one or other of three simple laws. In an *arithmetical progression* any term exceeds the preceding term by a constant difference, so that the general form of the series is $a, a + d, a + 2d, \dots$, where d is the *common difference*. The n th term is $a + (n - 1)d$. The formula for the sum of n terms is simple. Thus, let $s = a + (a + d) + (a + 2d) + \dots + l$, where l is the last term, or $l = a + (n - 1)d$. Writing the series in reverse order, we have also $s = l + (l - d) + (l - 2d) + \dots + a$. Hence, by addition, $2s = (a + l) + (a + l) + (a + l) + \dots + (a + l) = n(a + l)$, and $s = \frac{1}{2}n(a + l)$. It is sometimes convenient to use the result in the form $s = \frac{1}{2}n[2a + (n - 1)d]$. The other two progressions are *geometrical* and *harmonical* progression, for which see separate articles.

Prohibition (Lat. *prohibitio*, prevention, from *prohibere*, to forbid), sumptuary legislation forbidding the manufacture and sale of alcoholic liquors for use as beverages. Its aim is to abolish, by constitutional means, that which Prohibitionists consider an evil pernicious to humanity. The idea of prohibition is not a new one. In different countries and at various periods men have come to the conclusion that physiologically the use of intoxicating beverages is injurious to the human race. Sociologists, too, have maintained that the traffic in alcoholic beverages was detrimental to the public good. From the earliest days of its existence to 1920 the House of Commons has passed some 400 Acts of Parliament dealing with the liquor question. The problem, however, is far from being settled, and the House of Commons has not yet seen its way to introduce absolute prohibition of the manufacture, sale, and importation of intoxicants for beverage purposes. The most notable Acts were the Metropolitan Police Act (1839), the Welsh Sunday Closing Act (1881), the Protection of Children Act (1889), the Intoxicating Liquors Act (1901), the Temperance

(Scotland) Act (1919), &c. A National Prohibition Party was inaugurated in London, and the United Kingdom Alliance, formed in Manchester in 1853, has constantly been urging the introduction of prohibition into this country. During the European War the question of prohibition was widely discussed. The Government, without adopting the policy of absolute prohibition, introduced exceptional sets of restrictions. On 31st Aug., 1914, the Intoxicating Liquor (Temporary) Restriction Act was passed, and the policy was extended between 1915 and 1917. A Liquor Traffic Central Control Board was instituted, and orders were made curtailing hours, prohibiting 'treating', &c. After the conclusion of the war, the Government announced their intention of introducing legislation for the purpose of putting the liquor trade on a new footing.

In the United States of America a strong prohibition movement was started early in the nineteenth century, one of the earliest measures being that which forbade the sale of liquor to Indians. Local prohibition was then adopted in many states, Maine being the first to establish it in 1851, and in 1868 a Prohibition party was organized in Maine and Michigan. During the European War, America introduced prohibition as a war-measure, and the scheme of national prohibition was referred to the individual states. On 29th Jan., 1919, the Government announced that national prohibition would come into force, as 36 states, Nebraska being the last, had voted in favour of the measure. In spite of President Wilson's veto, Congress passed the Prohibition Enforcement Bill in Sept., 1919, and on 16th Jan., 1920, national prohibition became law in the United States. The American Anti-Saloon League has been endeavouring to spread the prohibition movement in Europe. Some amusement was caused during 1922 by the discovery that American State-owned ships were not only carrying and serving liquor on board, but were actually advertising the fact in the United States to induce business. The anomaly was eventually removed and foreign ships, of whatever description or nationality, were likewise forbidden to enter United States ports with liquor, even under seal. In Russia the sale of *vodka* was prohibited by Imperial Ukase in 1914, and in France the sale of absinthe was banned in Feb., 1915. See *Local Option*.—BIBLIOGRAPHY: G. Hayler, *Prohibition Advance in all Lands*; J. C. Fernald, *Economics of Prohibition*; Sir J. Crichton-Browne, *Prohibition: Liberty*; A. Mee and J. S. Holden, *Prohibition: Defeat*.

Projec'tiles, *Theory of*, a branch of dynamics which discusses the problem of the motion of a body projected from a point on the earth's surface with any speed and at any angle of elevation. A perfectly general treatment of this

problem is very difficult, especially when the resistance of the air is taken into account, as it has to be if the theoretical results are to be of any value for practical applications. For unresisted motion, the problem is conveniently divided into two parts, the motion of the centroid, and the motion of rotation about the centroid. The latter motion is the same as if the centroid were at rest; and the motion of the centroid is the same as if the whole mass were concentrated at that point (see *Kinetics*). To find how the centroid moves, consider, as was first done by Galilei, the horizontal and vertical components of the motion separately. There is no horizontal force, so the horizontal velocity remains constant. The vertical velocity and vertical position change as if there were no horizontal motion. Hence if axes of x and y be taken through the point of projection, horizontally and vertically respectively, we have the equations: $x = Ut$, $y = Vt - \frac{1}{2}gt^2$; where x , y are the co-ordinates of the centroid at time t from the moment of projection; U , V are the horizontal and vertical components of the velocity of projection; and g is the acceleration of a falling body (see *Fall of Bodies*; *Gravity*). These equations represent a parabola with its axis vertical. To illustrate their use, we may take the problem of finding the angle of elevation which, for a given initial speed, gives the maximum range on the ground plane. When $y = 0$, we have $t = 0$, or $t = 2V/g$; the second value gives the time of reaching the ground. The value of x for this t is $2UV/g$, or $(U^2 + V^2)/g - (U - V)^2/g$; since $U^2 + V^2$ is the square of the initial speed, this is greatest when $U = V$, in which case the angle of projection is 45° .

Projection. See *Geometry*; *Map*; *Mechanical Drawing*; *Perspective*.

Prolap'sus A'ni, the protrusion of the lower part of the rectum through the anus, caused by straining in costiveness, piles, &c. Persons liable to this accident should be careful to regulate their bowels so as to prevent costiveness and consequent straining. Regular bathing of the parts with cold water may also be found useful.

Prolap'sus U'teri, 'falling down of the womb', or 'bearing down', a common affection among women who have borne large families, but sometimes occurring in virgins, and in very rare cases in infants. What renders the falling down of the womb possible is a general laxity of the parts supporting it, and it may be of various degrees, from the slightest downward displacement to such a descent as causes external protrusion of the womb. When the falling down once begins it always tends to increase, unless means are taken to prevent it. In all cases of this affection the first requisite for cure is prolonged rest in the horizontal position, with the use,

under surgical direction, of cold or astringent injections and the various forms of pessary.

Prologue and Epilogue. A prologue is an introductory or prefatory piece of writing. In this general sense the most famous of all prologues is perhaps the prologue to the *Canterbury Tales*. The word is, however, usually employed in the sense of a discourse or poem spoken as the introduction to a dramatic performance. The Greeks originally applied the term *prologos* to all that portion of the play that came before the first chorus, but from the time of Euripides this became a monologue containing a narrative of facts introductory to the main action. By the time of Euripides plots were becoming more and more scarce; he did not wish to adopt trite themes, and so went into the by-ways of mythology or adopted a less well-known alternative version of a well-known legend. He could not count on his audience already possessing enough knowledge of the story to enable them to understand his plays without a prologue. There is sometimes a rich vein of irony in the Euripidean prologues; this is especially noticeable in the *Hippolytus*, where the prologue is spoken by Aphrodite. There were no prologues in Aristophanic comedy, but Plautus and Terence invariably made use of an epexegetic prologue. In the prologue to the *Rudens*, which is spoken by the star Arcturus, Plautus rose to great heights of poetry. The prologue played an important part in Elizabethan drama, though in the days of Shakespeare's maturity it was becoming somewhat old-fashioned. It is noteworthy that the most lamentable comedy of *Pyramus and Thisby* has an explanatory prologue; the prologue to *The Murder of Gonzago* is 'brief as woman's love', and merely apologetic. *Romeo and Juliet* has an immature prologue in the form of a sonnet; in the *Second Part of Henry IV* the prologue is spoken by 'Rumour painted full of tongues'. *Henry V* has an apologetic prologue, and that curious play *Troilus and Cressida* has an explanatory prologue. *Henry VIII* and *Pericles* have prologues which are not the work of Shakespeare. Ben Jonson delighted in the prologue, but frequently embedded it in a more elaborate Induction. Beaumont and Fletcher did not make much use of the prologue. After the Restoration it enjoyed a great vogue which lasted until about the middle of the nineteenth century. Many of these prologues were elaborate essays in verse, and were used to give a literary flavour to work of which the merits, if any, were purely dramatic. It was a common practice to get a well-known poet or verse-writer to write these prologues, which were often quite unconnected with the play.

An epilogue (the word originally meant the prororation of a speech) is a valedictory or

apologetic speech or short poem addressed to the spectators by one of the actors after the conclusion of a play. The epilogue was always much less an integral part of the play than the prologue. It was unknown in Greek drama, and in Latin comedy usually consisted of a brief formula such as 'vos valet et plaudite' (Farewell, and clap your hands). Shakespeare used the epilogue in several plays. In *A Midsummer Night's Dream* Theseus says "No epilogue, pray you, for your play needs no excuse"—showing that the function of an epilogue was mainly apologetic. There are epilogues in *A Midsummer Night's Dream*, *Henry IV Part 2*, *Henry V*, *All's Well that ends Well*, *As You Like It*, *Troilus and Cressida*, and *The Tempest*, as well as in *Henry VIII* and *Pericles*. Jonson usually provided his plays with a defiant epilogue; that appended to *Cynthia's Revels* contained the notorious line:

By God 't is good, and if you like 't you may.

After the Restoration the epilogue shared the fortunes of the prologue. Both were written with great elaboration by Dryden, and by later and less efficient writers, and both fell into disuse in mid-Victorian days.

Prome, a District and town in the Pegu Division of Lower Burmah. The district stretches from east to west across the Irawadi Valley, and has an area of 2915 sq. miles. Prome has a much drier climate than the rest of the Pegu Division. 90 per cent of the population is Burman and the Burmese language predominates. Rice is cultivated.

According to tradition Prome, once a flourishing kingdom, was founded by a king named Dutabaung of the Pyu tribe, who, with the Arakanese and other tribes, constituted the Burman race in the remote ages. Prome is, then, the traditional cradle of the Burmese race. *Pyi* is the Burmese name for Prome. The town is on the Irawadi, and is the terminal of the railway from Rangoon. Within it lies the Shwesdaung pagoda, 80 feet high, with a gilded dome. It stands on a platform of stone, and is supposed to contain four genuine hairs from Gautama's head. Pop. (district), 380,000; (town), about 27,000.

Prome'theus, in Greek mythology, one of the Titans, brother of Atlas and of Epimetheus, and the father of Deucalion. His name means 'forethought', as that of his brother Epimetheus signifies 'afterthought'. He gained the enmity of Zeus by bringing fire from heaven to men, and by conferring other benefits on them. To punish this offence Zeus caused Prometheus to be chained by Hephaestus (Vulcan) on a rock of the Caucasus (the eastern extremity of the world, according to the notions of the earlier Greeks), where his liver, which was renewed

every night, was torn by a vulture or an eagle. He was ultimately delivered by Heracles. That is the tradition as shaped by Æschylus, who has a noble tragedy on the subject, the *Prometheus Vincitus* (Prometheus Bound), while Shelley has also a drama, the *Prometheus Unbound*. A different version is given by Hesiod.

Promise, in law, an engagement entered into by one person to perform or not to perform some particular thing. When there is a mutual promise between two parties, it is termed a contract. A promise may either be verbal or written. A verbal promise is in England called a promise by parole, and a written promise is in technical language designated a covenant. By English law no promise is binding unless it was made for a consideration, but by Scots law it is always binding whether a consideration was given or not. The law of Scotland makes a distinction between a promise and an offer, the former being an engagement of such a nature that it is unnecessary to secure the consent of the person to whom the promise is made, while the latter is an engagement dependent on the assent of the other party.

Promissory Note. A promissory note is defined by the Bills of Exchange Act as "an unconditional promise in writing made by one person to another, signed by the maker, engaging to pay, on demand, or at a fixed or determinable future time, a sum certain in money, to or to the order of a specified person or to bearer". In form it is usually as follows:

£50. London, 30th November, 1922.

Three months after date I promise to pay to Mr. A— B— or order the sum of Fifty pounds, for value received.

(Signed) X— Y—.

A promissory note is inchoate and incomplete until delivered to the payee or bearer. The note may be made by two or more parties, who may be liable thereon jointly, or jointly and severally, according to its terms. If the note runs 'I promise to pay' and is signed by two or more persons, their liability is joint and several. A promissory note payable on demand must be presented for payment within a reasonable time after it has been endorsed, failing which the endorser is discharged. What is a reasonable time depends on the usage of trade or the facts of the particular case. The maker of a promissory note is bound to pay it according to its tenor, and is precluded from denying to a holder in due course the existence of the payee or his then capacity to endorse. In general, the rules applicable to bills of exchange apply also to promissory notes with certain obvious exceptions, e.g. those regarding acceptance. A promissory note

must be duly stamped, and any person who takes or receives an unstamped note, either in payment or as a security, or by purchase or otherwise, is not entitled to recover thereon or to make it available for any purpose whatever.

Prong-buck, or **Prong-horn Antelope**, a species of antelope, the *Antilocapra americana*, which inhabits the western parts of North America. It frequents the plains in summer and the mountains in winter. It is one of the few hollow-horned antelopes, and the only living one in which the horny sheath is branched, branching being otherwise peculiar to deer which have bony antlers. This sheath is shed every year.

Proof Impression, in printing, a rough impression from types, taken for correction. A first proof is the impression taken with all the errors of workmanship. After this is corrected another impression is printed with more care to send to the author; this is termed a *clean proof*. The first proof before going to press is called a *press proof*, but there are usually intermediate proofs called *revise proofs* or *revises* simply. In engraving, a proof impression is one taken from an engraving to show the state of it during the progress of the work; also, an early impression, or one of a limited number, taken before the letters to be inserted are engraved on the plate. Proof states of engravings are usually distinguished as (1) *Artists' proofs*, with no engraved title, sometimes signed in pencil by the painter or engraver, or both. *Remarque* artists' proofs have some mark, frequently a minute part left white, or a design slightly engraved on the margin. (2) *Proofs before letters*, still without title, but with artist's and engraver's names inserted close to the bottom of the work, and the publisher's name near the lower margin of the plate. (3) *Lettered proofs*, with title engraved lightly in such a manner as to be easily erased, or in open letters ready for shading, when the title is finally put on the plate for the ordinary impressions. See *Correction of the Press*.

Propagan'da, an association, the congregation *de propaganda fide* (for propagating the faith), established at Rome by Gregory XV in 1622 for diffusing a knowledge of Roman Catholicism throughout the world, now charged with the management of the Roman Catholic missions. In close connection with it stand the seminaries or colleges of the Jesuits, and the great majority of the members of the propaganda are Jesuits and Franciscans.

Propagation, the multiplication or reproduction of the species of animals or plants. As a technical term it is used chiefly in regard to plants. The most common method of propagating plants is of course by their seed. There

are other ways, however, by which plants are propagated naturally (vegetative reproduction). Some, for example, throw off runners from their stems which creep along the ground, and these runners take root at the nodes, and send up new shoots. The commonest artificial methods of propagating plants are budding, layering, the various forms of grafting, including inarching or grafting by approach, propagation by offsets and by slips. Some plants (as the potato) are propagated by dividing the tubers or underground stems, each 'eye' or leaf-bud of which produces a new plant, while a few are propagated by cuttings of the leaves. Some microscopic plants (bacteria) and animals (many Protozoa) propagate by division or fission. The former (e.g. yeast plant) may also reproduce by budding or gemination, as do many lower animals, especially the Hydrozoa, Polyzoa, and Ascidians.

Propertius, Sextus, in many ways the greatest of Roman elegiac poets, was born at Assisi about 50 B.C., and died about 15 B.C. Little is known about his life except what is derived from his poems. He came of a well-to-do though not aristocratic family; his father died while he was a boy, and after the battle of Philippi he was deprived of his estate and reduced to poverty. He proceeded to Rome, where he received a good education, and, after some attempts at a career at the Bar, settled down to the more congenial occupations of a *littérateur* and man about town. He met his mistress Cynthia (Hostia was her real name) when he was about twenty years of age, and soon after commenced to write poetry. Cynthia was an upper-class courtesan; her *liaison* with Propertius lasted some six years, but was broken by many quarrels and one complete year of estrangement. She had not an attractive character, being vain, fickle, greedy for gain, and hasty of temper. It is doubtful whether the poet was genuinely in love with her; to some extent she was part of his poetical outfit. His first book of poems was published in 25 B.C. It caused a revolution in elegiac poetry. Its opening lines,

Cynthia prima suis miserum me cepit ocellis
Contactum nullis ante cupidinibus,

struck a new note, and widened beyond belief the possibilities of the elegiac couplet. Cynthia died in about 23 B.C.; little is known of what happened to Propertius after her death. He was patronized by Mæcenas, and was a friend of Virgil and of Ovid. On more or less negative evidence, it is very probable that Horace and he were on bad terms.

The poems of Propertius consist of over four thousand lines of elegiac verse; most of his poems are love-poems connected with Cynthia, some few (especially in the last book) are political

or historical, and were probably inspired by Mæcenas. His work has many unique qualities which both attract and repel. It is highly characteristic of the man who wrote it. He was a highly strung and brilliant young man, somewhat effeminate and neurotic. He woke one day to find himself famous, and worked for some years at the somewhat thin vein of poetry which was in him. He never caught the 'fine careless rapture' of his first book, though there is deeper knowledge of the human heart in some of his later work. After the death of Cynthia he became a young man with a great past behind him. Yet he did not feel for her the genuine passion that animated the love lyrics of Catullus. The difference between Propertius's love for Cynthia and that of Catullus for Lesbia is the same as the difference between Romeo's love for Rosaline and his love for Juliet. Propertius, in fact, is in love with being in love, and is always more interested in himself than in his mistress. He is a highly artificial poet, and in order to understand him it is necessary to have frequent recourse to Lemprière and to Sir William Smith. He was an admirer of Callimachus, Philetas, and the Alexandrian school of poetry in general; much of his work is merely rather better than Catullus at his worst. It is forced and unnatural to a degree, and is no more genuine poetry than the work of a 'tenth transmitter' of the Popian tradition in the eighteenth century. Now and again, when he can forget himself, Propertius rises to great heights of poetry, as he does in his noble elegy on Cornelia. Had he always written thus, "it had been vain to blame, and useless to praise him". As a metrist it is impossible to praise Propertius too highly. Catullus's elegiacs were almost as rough as the hexameters of Ennius; those of Ovid are elegant to the verge of monotony; Propertius is the happy mean between these two extremes. He alone raised the pentameter to the dignity of its heroic consort.—**BIBLIOGRAPHY:** W. Y. Sellar, *Horace and the Elegiac Poets*; H. E. Butler, *Sexti Properti Opera Omnia*, and *Propertius* (text and translation, Loeb Library); J. S. Phillimore, *Propertius* (text, index verborum, and translation).

Property (Lat. *proprius*, one's own), in law, is the right of ownership of a subject—"the entirety of the powers of use and disposal allowed by law" (Pollock, *Jurisprudence*). It is a higher right than that of possession (q.v.), for the power of disposal is an essential element in the right of property which is lacking from mere possession—one can scarcely conceive of an *owner* who has no power to dispose of the things he owns—and, further, the right of ownership necessarily implies a right to claim and maintain possession against all the world. But the right of property or ownership may quite well be limited in certain

directions either for a time or in perpetuity. Thus the owner of an article may let it out to another person for a period, and he thereby temporarily cedes possession and limits his right of property as to use and disposal; or again, the right may be subject to a permanent limitation and transferable only under burden thereof, as when an easement or servitude exists over a plot of ground in favour of another person or subject or of the public, e.g. a right of way. In short, "the owner of a thing is not necessarily the person who at a given time has the whole power of use and disposal; very often there is no such person. We must look for the person having the residue of all such power when we have accounted for every detached and limited portion of it, and he will be the owner even if the immediate power of control and use is elsewhere. In the same way a political sovereign does not lose his independence merely because he has made a treaty by which he has agreed to forego or limit the exercise of his sovereign power in particular respects" (Pollock).

Property may be acquired in several ways, e.g. by taking possession of a thing which has no owner, by gift, inheritance, purchase, &c., but certain subjects, e.g. running water, navigable rivers, and highways, cannot be held in private ownership. See *Land Laws*.

Property Tax, a tax similar to the income-tax (of which indeed it forms a part), being levied at the same rate on the annual value of real property of which a person is owner.

Prophet and Prophecy. Prophecy is usually regarded as a phenomenon peculiar to the Hebrew people. Every literary history of Israel contains a chapter on the Prophets, and the literary history of no other nation would contain such a chapter. The English word 'prophet' is simply a transliteration of the Greek word by which the Greek translators of the Hebrew Bible in the century or two immediately before the Christian era rendered the Hebrew word *nabhi*. The popular idea of a 'prophet' as a person who predicts events before they happen, although not unknown to the Hebrews (*Deut.* xiii, 2; xviii, 22; *Is.* xli, 22, &c.), really comes from the Greek. The Hebrew word *nabhi* means no more than 'spokesman' or 'informant'. The verse which gives the clearest definition of its meaning is (as noted by Spinoza) *Ex.* vii, 1: "I have made thee a god to Pharaoh, and Aaron shall be thy prophet". Aaron is Moses' spokesman, just as the prophet is spokesman for God. The nearest English equivalent is the word 'preacher' (which is only 'predicter' writ small). The acknowledged head of the ideal theocracy is a prophet (*Ios.* xii, 13), but what distinguishes the prophet from other religious or political or military leaders is that he is *unofficial*. He may

belong to any tribe, and to any of the four estates. In this he is distinguished especially from the priests, whose office was hereditary, and who were all Levites.

The essential thing about the prophet is that he is in touch with God, and receives direct communications from Him. Hence he is above the law and the civil authority, and from what he says there is no appeal. He resembles the Muslim *soofee* or mystic, who rejects all authority, and derives his religion directly from God; and in the authority he wields the prophet is like the Shareef, who is in reality above the Sultan. This mystical power is not miraculous; it can be acquired. Both the *soofees* and the prophets undergo courses of training at the hands of acknowledged teachers (*2 Kings*, iv, 38); both have recourse to music and other means to bring about a state of trance (*1 Sam.* x, 5; *2 Kings*, iii, 15); both wear a distinguishing garb (*Zech.* xiii, 4); and both, when in a state of ecstasy, sometimes appear to the official class as insane (*2 Kings*, ix, 11; *Jer.* xxix, 26). Hence some passages, which were formerly regarded as exalting the prophetic office, are now by some supposed to imply contempt for it (*1 Sam.* x, 12; *Amos*, vii, 14). Prophecy in its highest form, however, has shed these accessories, and tends to become more purely 'terary'. The old name 'seer' (*rô'eh*) was dropped, that of *nabhi* taking its place (*1 Sam.* ix, 9).

The long line of Hebrew prophets may be regarded as beginning with Samuel some time about the year 1000 B.C., and ending with John the Baptist and Jesus Christ, although the name is applied to some who lived before (e.g. Abraham and Moses) and to others who lived after this period (as Agabus, *Acts*, xxi, 10, &c.). Prophecy in Israel frequently suffered an eclipse; there were periods when no prophet appeared (*1 Sam.* iii, 1; *Ps.* lxxiv, 9). Yet a remarkable recrudescence of prophecy is found in the person of Mahomet in Arabia in the seventh century, and some modern writers, such as Thomas Carlyle, only reiterate the words of the Hebrew prophets.

The central doctrine of the Hebrew prophets is monotheism—that God is *one*. Attempts have been made to show that the earliest of them—Elijah, for example—were not monotheists but henotheists, that is, that they did not recognize Jehovah as the only god in heaven and earth, but as the only god for the Hebrews, whilst they did not object to Baal being worshipped in Phœnicia or Rimmon in Damascus (*1 Kings*, xvi, 32; *2 Kings*, v, 18). For this the evidence is very meagre. All we know is that the earliest prophets whose writings have come down to us, Amos and Hosea, are thoroughgoing monotheists. The same Jehovah who brought the Israelites out of Egypt also brought

the Philistines from Crete and the Aramæans from Kir (*Amos*, ix, 7). It was a deep sense of the divine omnipresence that kindled "rapt Isaiah's wild seraphic fire" (chapter xi ff.). No doubt even the latest writers speak of a multiplicity of gods (*Ps.* lxxxii, 1, &c.), but only in the same sense in which we do so still. Yet the craving for tangible objects of worship clung to the Jews even in late post-exilic times (*Is.* lxxv f.). At the same time, as far as the better part of the nation is concerned, it would be difficult to put a belief in the unity of God too early. Indeed, monotheism seems to be an instinct with the Semitic peoples.

But this monotheism is not a mere philosophic doctrine: it is practical and moral. As the one God is essentially just, benignant, forgiving, so He requires the same qualities in His worshippers. Indeed the cultivation of these virtues is the truest worship of God. In the familiar words of Micah, "to do justly, to love mercy, and to walk humbly with God" is the only worship which He requires. It is at this point that prophetism comes into collision with the priesthood and the ritual law. Each prophet in turn, beginning with Samuel (*1 Sam.* xv, 22), rejects the ceremonial worship of his day, whether it were carried on at popular shrines and sacred stones and trees, as in the days of Amos and Hosea, or centralized in the temple of Jerusalem, as in the time of Isaiah and Micah, in words which have become classic (*Hos.* vi, 6; *Is.* i, 11 ff.; *Mic.* vi, 8). The whole book of *Amos* is a plea for justice, especially justice for the poor (v, 24). Hosea, like Socrates, identifies virtue and knowledge; it is because the Israelites do not know Jehovah that they imagine He can prefer sacrifice to mercy. Isaiah and Micah, so different in every other respect—the one a wealthy courtier and patriotic citizen of the capital, the other a poor countryman to whom all nations were more or less alike—are at one on this point, and the terms in which Micah has expressed it have been well called by the late Professor Wellhausen "the egg of Columbus". Jeremiah, himself a priest, will not allow that worship by sacrifice was ever enjoined upon the Israelites at all (vii, 22 f.). In him Israelite prophecy reaches its high-water mark, for, whilst his predecessors demanded a new life, he first insists upon the *new heart*. Other writers outside the recognized ranks of the prophets, and perhaps later than they, take up the same refrain (*Ps.* l, 7 ff.; li, 16 f.). Ezekiel, also a priest, almost puts himself outside the prophetic circle, for in his Hebrew Utopia (chapter xi ff.) ritual plays a very large part, but, on the other hand, he insists upon morality as emphatically as the rest. Hebrew prophecy culminates in John the Baptist and Jesus.

Sacrifice now no longer held its old place; worship was believed to consist rather in the *study* of the Law. Hence arose an elaborate and intricate system of casuistry, comparable only to that of the Jesuits in later days. In place of this impossible burden John put the few simple duties of common life (*Luke*, iii, 10 ff.). Jesus reduced the innumerable ordinances of the Pharasaic tradition to two—love of God and of one's neighbour. With the fall of Jerusalem the long strife came to an end.

From a political point of view the Hebrew prophets have been called the "stormy petrels of history". They are the heralds of the storm, and generally they come in pairs. Elijah and Elisha are the precursors of revolution both in Samaria and in Damascus; Amos and Hosea, even in the prosperous times of Jeroboam II, foretell the sweeping away of the northern kingdom as imminent, as Isaiah and Micah do that of Judah also; Nahum is the herald of the downfall of Nineveh, and Habakkuk of that of Babylon. But besides the main theme of their mission, each of the prophets in turn makes a wide survey of the whole world as known to him. Hence a series of prophecies 'against foreign nations' (*Amos*, i and ii; *Is.* xiii-xxiii; *Jer.* xlii-li; *Ezek.* xxv-xxxii). These prophecies, both home and foreign, are frankly pessimistic, and in Jeremiah, who witnessed the crowning calamity, this pessimism reaches its lowest depths. It is worth asking whether these gloomy utterances did not do much to bring about their own fulfilment. But once the cloud had burst, a ray of hope began to appear. Ezekiel, in exile, foresees Israel restored, and the 'great unknown' (*Is.* xl ff.) paints in gorgeous colours the glories of the Return. Even amid its realities Haggai and Zechariah are hopeful. But a century later the clouds have gathered again, and the last of the old prophets sounds a note of sadness. What saves the prophets from despair is their belief in a 'remnant', that each new turn in the fortunes of the people, whilst calamitous for the mass, left a purified residue behind (*Is.* vi, 13, &c.; *Mal.* iv, 2).

The doctrine of a 'remnant' (which we owe to Isaiah) is connected with what are called 'Messianic prophecies', the pictures of the ideal future kingdom under the ideal king, the reign of peace and goodwill upon earth, the golden age of the future (*Is.* xi, 1-10; *Mic.* iv, 3, 4; *Dan.* vii, 13, 14), when the days of Cronos should return. But this matter comes rather under the head of Apocalyptic than of Prophecy, although one point to which attention may be drawn here is the deep, almost tragic sense of responsibility which is present in all, but which Ezekiel alone puts into words (iii, 17 ff.).

The Hebrew prophets hold the same place in Israel as do the philosophers in Greece. They are the moral and intellectual guides of the people. In Greece there were also the sophists, and in Israel the false prophets. But between the Greek philosopher and the Hebrew prophet there is a vast difference in method. The former is guided by reason, the latter by intuition. The result is that the truth which the former attained only after a laborious process of reasoning, the latter perceives almost unconsciously. He starts from the point at which the philosopher ends. Moreover, the aim of the one is different from that of the other. A great deal of Western philosophy is taken up with the mere definition of terms, although it is obvious that to define a name, the content of which is always changing, is alike impossible and futile. The Eastern thinker does not trouble to define terms the contents of which are common knowledge. Names are nothing to him but the ideas which they express. He does not care to define the good or the true, mercy or humility. He takes these for granted, and his one aim is to get men to practise them. He is concerned with things, not words, with doing, not abstract thinking. The result is that if the whole of Greek philosophy and all it stands for were taken out of human life to-day, the toiling millions of mankind would not be conscious of any change. But if the Hebrew prophets had neither existed nor taught, life would be a different thing for one-half of the human race to-day.

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Propontis, the ancient name of the Sea of Marmara, from being before or in advance of the Pontus Euxinus or Black Sea.

Proportional Representation is the end for the attainment of which numerous schemes—said to number about 300—have been devised during the last half-century. It is generally admitted that our present system of parliamentary elections falls short of perfection, especially in its failure to provide for a fair and reasonable representation of minorities.

One device is that known as the *cumulative vote*, by which each elector has as many votes as there are candidates to be elected, and allots them as he pleases. It is argued that by this method an organized minority can pool its votes and secure adequate return of its party; but the system has been found to work capriciously, and the *transferable* or *alternative vote* is generally preferred. Under this system each elector marks his voting-paper with (1), (2), (3), and so on, according to his preference for the candidates. To secure election a candidate must obtain a certain number of votes, called the *quota*, which is fixed by dividing the number of voters by one more than the number of seats vacant. At the first count only first choices are considered, and those candidates who obtain their *quota* from such votes are declared elected. If, as will usually happen, there are still seats to be filled, the surplus votes of the elected candidates are transferred in proper proportion to the second choices of the electors who voted for those candidates as their first choice. For example, if the *quota* is 3000, and a candidate receives 4000 first votes, 1000 of his papers, i.e. one-quarter of the total 4000, are available for the second choices marked on them; and each unelected candidate is given one-quarter of those papers on which he is indicated as second choice. If after these transfers the number of candidates who have secured their *quota* is still insufficient, the lowest candidate is rejected, and a first vote given to him on any paper is transferred to the next preference shown on that paper. This process of rejection and transfer is repeated till the required number is elected. Proportional representation by this method was first advocated by Thomas Hare in 1857, and received a few years later strong support from John Stuart Mill, who wished the country to be regarded for election purposes as one single constituency. One or other of the many systems advocated has been adopted by various countries on the Continent and overseas, as also for the municipal elections in Ireland and for those of the Scottish Education Authorities.

Proposition, in grammar and logic, a sentence or part of a sentence which consists of a subject and a predicate, and in which something is affirmed or denied of a subject. Logical propositions are said to be divided, first, according to substance, into *categorical* and *hypothetical*; secondly, according to quality, into *affirmative* and *negative*; thirdly, according to quantity, into *universal* and *particular*.

Propylæa, in Greek architecture, the entrance to a temple. The term was employed particularly in speaking of the superb vestibules or porticoes conducting to the Acropolis of Athens. This

magnificent work, of the Doric order, was constructed under the direction of Pericles (437-433 B.C.) after the designs of the architect Mnesicles.

Prorogation of Parliament, the continuance of Parliament from one session to another, as adjournment is a continuance of the session from one day to another, or for a longer period. Prorogation determines the session, but adjournment, though for a fortnight, month, &c., does not. After a prorogation any Bill which has previously passed both Houses, or either House, without receiving the royal sanction or the concurrence of the other House, must be taken up *de novo*. Parliament is prorogued by the sovereign's authority, either by the Lord Chancellor in the royal presence, or by commission, or by proclamation.

Proscription, in Roman history, a mode of getting rid of enemies, first resorted to by Sulla in 82 B.C., and imitated more than once afterwards in the stormy years that closed the Republic. Under Sulla, lists of names were drawn out and posted up in public places, with the promise of a reward to any person who should kill any of those named in the lists, and the threat of death to those who should aid or shelter any of them. Their property also was confiscated, and their children were declared incapable of honours.

Prose (generally derived from *prorsa* (*oratio*), the reason of which will be given in the course of the article). The true character of prose can be clearly conceived only by considering it in relation to poetry. Their difference lies in the essential difference of certain states of the mind and feelings. The two chief states of the inward man may be called the *thinking* and the *poetical* states, and depend upon the predominance of the understanding, or the imagination and feelings. If we think (in the narrower sense of the word) we combine ideas according to the laws of reason; and prose, which is the language of sober thought, is characterized by the abstractness and generality of precision belonging to ideas that occupy the understanding. Prose, in the most common acceptation of the word, is used in contradistinction to metrical composition. The external form naturally strikes first, and in the early stages of society strikes most; hence the term *prose*, which, as we have already stated, is derived from *prorsus*, *prorsa oratio* (straight or direct speech), opposed to *verse*, which is derived from *versus* (turned), returning always to the selected metre. The Greeks called prose *ho pezos logos*, which the Romans translated *pedestris oratio*; and St. Evremond compares prose writers to modest pedestrians. Prose was also called by the Romans *oratio soluta* (free speech), in opposition to *oratio vincla* (bound

speech) or verse, which is bound by rhythmical laws. From what has been said of the difference between prose and poetry, it is clear that poetry must be much earlier developed than prose. Strong personal feeling naturally demands rhythmical expression, and in the early stages of society such is the only motive that is capable of leading to literary production. Oratory, it is true, selects a prose vehicle; but there is this difference between oratory and poetry, that the orator rather governs his feelings and directs them towards a practical object—that of inciting his hearers to some resolution—than allows himself to be swayed by them; whereas the poet allows himself to be swayed so far as is consistent with literary expression. Whenever the understanding predominates, as it does in oratory, prose is the natural vehicle; and although it is the case that histories, laws, and philosophical maxims were first conveyed in verse with the Greeks and many other nations, this may be explained partly by the fact that verse had established itself as the regular literary medium, and partly by this, that in these early times civilization was not sufficiently far advanced for the purely intellectual to be predominant over the emotional interest except in the one case of oratory. Pliny says that Pherecydes of Seyros (a contemporary of Cyrus) first formed the Greek prose (*prosam primus condere instituit*); but perhaps he was only the first who wrote on philosophico-mythological subjects in prose. Fine prose is among the latest attainments both of nations and individuals, and it would appear that with most nations classical prose writers are fewer than classical poets.

Prosecution, Criminal. By the law of England the Solicitor to the Treasury is director of public prosecutions in cases where the public interest is mainly concerned. By the law of Scotland that function is assigned to the Lord Advocate and his assistants the advocates-depute, and the procurators-fiscal of burghs and counties. In England, in the less serious offences not affecting the public interest, it is sometimes left to the private parties more immediately concerned to institute criminal proceedings. The result of this is that many criminals are sometimes allowed to go free merely for want of a prosecutor.

Pros'elyte (Gr. *prosēlytos*, a stranger or newcomer), in religion, a person who leaves one religion for the profession of another. The Jews, in New Testament times at least, had two classes of proselytes, namely, the 'proselytes of the gate', as they were termed; and the 'proselytes of righteousness', or of the covenant. According to the rabbis the proselytes of the gate were those who renounced idolatry and

worshipped the only true God according to the (so-called) seven laws of the children of Noah, without subjecting themselves to circumcision and the other commands of the Mosaic law. The proselytes of righteousness were persons who had been fully converted from paganism to Judaism, had been circumcised, and bound themselves to observe the Mosaic law.

Prosobranchiata, an order of gastropod molluscs comprising the whelks, periwinkles, &c., mostly marine, though some inhabit fresh water. The gill or gills, when present, are in front of the heart. See *Mollusca*.

Prosody (Gr. *prosōdia*, a song sung to music, a mark of quantity, from Gr. *pros*, to, and *ōdē*, song), the correct pronunciation of words. It is that part of grammar which treats of accents, of the quantity of syllables, and of the laws of versification.

Greek grammarians employed the term prosody in relation to all the marks which, added to letters, characterized more exactly the sounds of speech. Such marks were accents, quantity, and breathings. In modern times the term prosody is applied only to the recognition of rhythmical form in verse. Under *accent* we understand the stress of the voice upon a syllable in pronouncing it. *Quantity*, on the other hand, is the time required for the effort in pronouncing a syllable. The ancients had very strict rules for the quantity of syllables, and the Greeks employed different letters to designate the long and short *o* (ω , o), and the long and short *e* (η , e). The principal element of poetry for the Greeks and Romans was the length of time and the quantity, or the combination of long and short syllables, two short ones equalling one long syllable. Verse depended upon the value of syllables. In modern languages, such as German, Spanish, and Italian, verse may consist of lines where the syllables are counted and not measured. In English verse the rhythm is based upon accent, i.e. the measured undulation of accented and unaccented syllables is its essential feature. French verse consists of lines containing from one to sixteen, or from one to nine syllables. The former have pauses, or *cæsuras*, whilst in the latter the rhyme or assonance determines the music of the verse. The unit of measurement is the metrical *foot*, or group of two or three syllables forming the basis of line or verse. The five chief measures of English verse are the following: the *iambic*, in which the unaccented syllable precedes the accented (\sim —); the *trochaic*, in which the unaccented syllable follows the accented (— \sim); the *anapestic*, in which the two unaccented syllables precede the accented ($\sim \sim$ —); the *dactylic*, in which the two unaccented syllables follow the accented (— $\sim \sim$); and the *amphibrachic*, in which the accented syllable is both

preceded and followed by an unaccented (\sim — \sim). For fuller details see *Verse*.

Proso'pis, a genus of tropical leguminous trees of the sub-ord. Mimosæ, having their pods filled between the seeds with a pulpy or mealy substance. Some of them yield useful products, as resin or tannin, food for cattle, &c. See *Mesquite*.

Prospectus. A prospectus is a document issued by a company or its promoters to members of the public, and designed to induce the public to take up shares or debentures of the company. It is defined in the Companies (Consolidation) Act, 1908, as "any notice, circular, advertisement, or other invitation, offering to the public for subscription or purchase any shares or debentures of a company". The Act lays down strict rules with which every prospectus must comply. A copy must be signed by each person named in it as a director or proposed director, or by his agent authorized in writing, and must be filed with the Registrar of Joint Stock Companies on or before the date which it bears and which is the date of its publication. Certain material particulars must be disclosed in it, namely, (a) the Memorandum of Association (which shows the objects of the company); (b) the qualification of the directors (which shows the extent to which the directors put faith in the company), also their remuneration; (c) the names, descriptions, and addresses of the directors (these disclosing the management of the company); (d) the minimum subscription on which allotment may proceed, and the amount payable on application and allotment; (e) the number of shares and debentures issued as fully or partly paid up otherwise than in cash, and the consideration given for the same; (f) the names and addresses of the vendors and the sums payable to each; (g) the amount of the purchase price, specifying the amount paid for goodwill; (h) the amount of underwriting commission; (i) the amount or estimated amount of preliminary expenses; (j) the amount paid to any promoter and the consideration therefor; (k) the dates of and the parties to every material contract made within the previous two years, and the place where they may be inspected; (l) the names and addresses of the auditors; (m) the interest of every director or promoter in the promotion or in the property to be acquired by the company; and (n) where the shares are divided into classes, the rights of voting attached to the several classes. These requirements are intended to safeguard the public against imposition and fraud. If the prospectus is issued more than one year after the company is entitled to commence business, the contents of the Memorandum, the particulars of the directors and of their qualification, re-

muneration and interest, the preliminary expenses, and the interest of the promoters need not be disclosed.

The framing of a prospectus requires the utmost care, as any untrue statement or failure to disclose a material fact may entitle an allottee to rescind the contract and have his name removed from the register, or to sue the parties responsible for the issue of the prospectus for damages at common law or for compensation under the Act for loss sustained thereby.

Prostate Gland, a glandular mass, situated in the pelvic cavity, which surrounds the neck of the bladder and urethra in males, in whom it forms part of the organs of reproduction. It is liable to enlargement, especially in old age, and is often the seat of various diseases.

Protagoras, Greek sophist and philosopher, born at Abdera, in Thrace, apparently about 480 B.C. He was the first to assume the title of Sophist, and as such he taught principally at Athens. In 411 B.C. he was accused of atheism, for beginning one of his works (*Peri Theōn*—Concerning the Gods) with the words "Respecting the gods, I am unable to know whether they exist or do not exist". He seems to have died soon after, perhaps in the same year. He was the author of a large number of works, all of which are lost. In Plato's dialogue named after Protagoras, the latter appears as an exponent of customary morality.

Protandrous Flowers, those in which the anthers mature before the stigma is ripe; this arrangement—like the converse condition of protogynous flowers, in which the stigma matures before the anthers—favours cross-pollination (q.v.).

Protea'ceæ, a natural order of arborescent apetalous dicotyledons, chiefly natives of Australia and the Cape Colony. They are shrubs or small trees, with hard dry opposite or alternate leaves, and often large heads of showy and richly coloured flowers, which render them favourite objects of cultivation. The typical genus, *Protea*, is African, and contains numerous species. *Banksia* is a well-known Australian genus bearing the popular name of honeysuckle.

Protection is the name given to any fiscal system through which it is sought by taxes laid on imported commodities to alter that distribution of industries which would prevail under free competition in foreign trade.

In the absence of such interference, competition would effect an international division of labour whereby each nation would specialize in the goods which it had the greatest advantages for producing as compared with other goods, and the maximum world output of commodities for a given amount of human effort would tend to result. This benefit is not only general to all

countries, but particular to each country engaged in foreign trade. For no country will import a commodity A if it can produce the same quantity itself at less cost than it can produce another commodity B which can be traded abroad in exchange for A. The direct and immediate benefit to a country of its foreign trade is the excess of the real value to it of its imports over that of the things which it could have produced for itself by the labour and capital needed for producing its exports and working the trade. The effect of a tax upon foreign trade is to force resources into less productive uses, and therefore to diminish the real income of all countries. A tax upon any particular commodity is paid, except in the case of a monopoly, by the consumer after enough time has elapsed for trade conditions to become stable. A tax upon all imports is paid by the consumers, except for an improvement in the terms on which native goods exchange for foreign. This will not be sufficient, in the case of the trade of one country with the rest of the world, to offset the loss due to obtaining goods in less efficient ways.

The principal arguments used in favour of protection are the following:

1. "If other countries adopt it we must." This does not follow; each additional impediment to trade results in further loss. But a high tariff can be used as a lever in negotiating with other countries to lower theirs.

2. There may be general social utilities not taken into account in merchants' and manufacturers' profits. Thus a country may prefer to remain poorer than it might be, rather than become preponderantly urban, or have its people engaged in degrading occupations, or become dependent for essential goods on countries with which it may one day be at war.

3. It may be possible to devise a fiscal policy which, while lessening the total national wealth, will benefit the poorer classes, so improving the distribution of wealth. (a) "Support home industries and so keep everyone in employment." But, since imports are paid for by exports, against increased employment in making things formerly imported there will be increased unemployment in making exports, and since production will be carried on at enhanced cost, the total demand for labour will be lessened. (b) Protection may increase the demand for labour relative to that for land and capital, or may cheapen commodities consumed by working people while those consumed by other people become dearer; thus labour may obtain a larger relative and even a larger absolute share of a diminished national income. (c) It is argued that a country cannot maintain better conditions of labour than others

unless it adopts protection. This is untrue, because foreign trade depends on a relative and not on an absolute lowness of costs.

4. Although the immediate results of foreign trade are beneficial, some of its ultimate results may not be, even in terms of prices and profits. Not only wealth but the power of producing wealth in the future should be the aim of national policy. (a) Protection of infant industries. A country may be well adapted to a certain industry, which, however, requires time for the development of banking, marketing, subsidiary industries, trained workmen, and technicians. Ultimately its product will be cheaper than the imported, but meanwhile it must be protected from the competition of more advanced rivals. (b) The cheapness of 'dumped' goods is an immediate benefit, but in the long run it may be less costly to do without them. (c) Under unrestricted foreign trade a manufacturing country will export to less developed countries machinery with which they will set up manufactures of their own, so ending a profitable trade.

In general, it may be said that the arguments for protection which are based on the conception of nations as competing business firms are fallacious. The whole world has become economically interdependent, and an increase in the wealth of any country will usually benefit all the other countries. Though a protective tariff may conceivably serve a useful purpose if it is well devised to meet some special need, experience has shown that in practice powerful business interests can usually exercise sufficient political power to divert a nation's fiscal policy from the path of scientific protection.—BIBLIOGRAPHY: F. List, *National System of Political Economy*; C. F. Bastable, *Theory of International Trade*; A. Marshall, *Industry and Trade* (book i, chapter ii); *White Paper on Fiscal Policy and Foreign Trade*; Sir William Ashley, *The Tariff Problem*; J. H. Higginson, *Tariffs at Work*.

Protection Order, in England, when a wife is deserted by her husband, she may apply to a magistrate for a protection order. Such an order has the effect of safeguarding her property from the claims of her husband and of his creditors and others claiming under him. If, after notice of the order, the husband or such other party does not hand over to the wife any property belonging to her which may be in his possession, or if thereafter he seizes any property belonging to her, he becomes liable to her in double the value. If adequate cause is shown by any of the above parties, the order may be discharged.

Protector, a title conferred on several occasions by the English Parliament upon those

appointed to act as regents, generally during the minority of the king. Among those who have held this office are Richard, Duke of York (1454); Richard, Duke of Gloucester (1483); and the Duke of Somerset (1547). In 1653 the title of Lord-Protector was bestowed upon Cromwell, as head of the Commonwealth of England, and after his death (1658) his son Richard also held the title for a short period.

Protectorate, a name applied to the régime of a protector, as in Britain between 1653 and 1659, during which Oliver and Richard Cromwell successively held the title of Lord-Protector of the Commonwealth. It is also applied in a general way to the protection extended by a strong power to a weak nation, and in particular to any native state or territory placed or taken under the protection of a European power. British protectorates include Uganda, Tanganyika, Kenya, Zanzibar, Somaliland, Swaziland, Bechuanaland, and Nigeria, all in Africa; and Sarawak, Mesopotamia, and Palestine, in Asia. The foreign relations of all these countries are under the exclusive control of the king-emperor. It is rather difficult to show exactly where a protectorate ends and colonization begins, but a protectorate may be explained in the following way.

Many British traders and merchants have penetrated to the heart of the Dark Continent, where there are numerous territorial divisions and innumerable tribal subdivisions and interrelationships. Just as the value of a colony to the European power lies in the creation of new markets for home-made goods and in the raw materials that the colony may be able to supply, so it is with a protectorate, in so much as the economic aspect is considered. In Africa many tribes are decidedly low in the scale of civilization, and to ensure peace and justice where the interests of British merchants are involved a protectorate over a certain tribal territory may be proclaimed. A Resident is sent out, who advises on questions of law and order, and maintains peace within the protected region. The amount of actual ruling performed by a British Resident varies greatly; in Uganda, for instance, the Consul-General (Resident) is all-powerful, and has a great deal to do with the administration and laws of that country. Uganda, in fact, is almost a Crown colony. In Somaliland the Resident takes little or no part in the actual government, and confines his work to the guarding of imperial interests.

Spheres of Influence.—Such zones or spheres may be described as territories where an interested power takes no direct hand in the Government, but in which other powers may not acquire territory, influence, nor indeed anything at all by treaty or *force majeure*. The general

tendency in the past has been for such spheres of influence gradually to become protectorates, since the natives have found that it is to their advantage to obtain from British officials direct help in maintaining law and order, and from the Empire a guarantee of territorial integrity and a tolerance and respect for minorities. From being protectorates it is a fairly short step to the higher stage, when they become colonies, and take their place eventually as autonomous nations in the Imperial Commonwealth. British 'spheres' are the Persian Gulf, Arabia, and North-Eastern Africa.

Mandatory Spheres.—Since the European War the League of Nations is empowered to entrust the internal development and good government of third-class states to first-class powers, such authority being conveyed in a document known as a 'mandate', the recipient being the 'mandatory power'. Britain has mandates for certain portions of former German Africa, Palestine, and Mesopotamia; while Australia has many of the South Sea Islands.

Proteins (Gr. *prōtos*, first), so-called because of their prime importance to animal and vegetable organisms, are extremely complex compounds of carbon, hydrogen, nitrogen, oxygen, and sulphur. They belong to the class of colloids—substances which do not diffuse through an animal membrane—and their colloidal nature explains many of their reactions, both within the body and with the chemical reagents of the laboratory. For long it has been known that the amounts of their constituent elements vary within fairly wide limits according to the particular protein examined, a finding readily explicable in the light of more recent work, which has shown that the proteins are to be regarded as made up of amino-acids linked together in a particular way (see *Physiological Chemistry*), and that the differences in complexity and reactions of the different proteins are due to differences in the number and type of their amino-acid components. The technical difficulties in the way of a complete protein analysis are very great, and our knowledge of their detailed composition far from complete, but the following figures give an idea of their variation in composition. The numbers are percentages.

	Egg Albumin.	Glialin (from wheat).	Caseinogen (of cow's milk).	Gelatin.
Glycine ..	0.0	0.7	0.0	16.5
Leucine ..	6.1	6.0	10.5	2.1
Glutamic acid ..	8.0	31.5	11.0	0.9
Tyrosine ..	1.1	2.4	4.5	0.0
Arginine ..	2.1	2.8	4.8	7.6
Tryptophan ..	Present	1.0	1.5	0.0
Cystine ..	0.3	0.5	0.1	—

No satisfactory classification of the proteins is yet possible owing to lack of detailed knowledge of their chemical constitution, but the following is one which is generally accepted and in which the proteins are arranged in order of increasing complexity.

Protamines.—Simple proteins consisting of two or three amino-acids, which have been demonstrated so far mainly in the milt and roe of fish. The amino-acids are mainly of the diamino-type and hence such proteins are basic in reaction.

Histones.—Slightly more complex proteins containing a larger number of amino-acids than the protamines but with the diamino type still preponderating. **Globin**, the protein part of *hæmoglobin*, the colouring substance of the blood, is generally regarded as belonging to this group.

Native Proteins.—This large group comprises the majority of the proteins occurring in solution in animal and vegetable tissues. They show wide variation in their amino-acid make-up, but all possess the common property of being coagulated by heat. The native proteins are subdivided into *albumins* and *globulins*, the former being soluble in pure water, the latter not in pure water but in dilute saline solutions.

Phosphoproteins.—Proteins characterized by the presence of phosphoric acid (not as nucleic acid) in their molecule. An important member of this group is *caseinogen*, the principal protein of milk.

Conjugated Proteins.—A class of proteins in which the protein group is combined with another organic grouping. This class includes the *nucleoproteins*, in which the protein part is combined with nucleic acid; the *chromoproteins*, combinations of a protein with a pigment, as in *hæmoglobin*; and the *glycoproteins*, in which the protein is combined with a carbohydrate group.

Scleroproteins.—This heterogeneous group includes the proteins of the hard skeletal structures of the organism. Belonging to this class are *collagen*, obtained from white fibrous tissue; *elastin*, from elastic fibrous tissue; and *keratin*, the substance of which epidermal structures such as skin, hair, nails, and horns are composed.

Proteolepaddæ, or Apoda, a family of Entomostraca, of which the only representative is *Proteolepas bivincta*, described by Darwin. It is a small maggot-like creature about one-fifth of an inch long, which lives in the mantle cavity of the cirripede *Alepas cornutus*.

Proterosaurus, one of the earliest fossil reptiles, found in the Permian Kupferschiefer of Thuringia and in the Magnesian Limestone of Durham. It is a rhynchocephalian, and thus allied to the modern *Sphenodon* of New Zealand.

Proterozoic, the name of the geological era preceding the Cambrian period, including periods in which life-forms no doubt existed, though their

traces in the rocks are few and unsatisfactory. See *Geology*.

Protestantism is the term applied to the religion of Christians who are outside the Roman Church. It describes them as 'orthodox' describes the Greek Church, in opposition to the Papal organization. It is not a negative term. To 'protest', in its original Elizabethan sense, means to 'testify', to make a positive affirmation or confession. A protester or protestant is one who gives a solemn, serious declaration of his opinions or convictions. As this is generally called out by some erroneous statement to the contrary, a protest acquires a negative association, but it is negative only in virtue of its positive content. Protestantism, etymologically, is therefore a positive aspect of the Christian religion. The word rose out of a minor incident in the Reformation struggle, when a minority of princes and free towns in Germany protested against the Diet of Speyer in 1529, rescinding by a majority a decision unanimously passed at a former meeting in 1526. The particular issue was the right of German princes to determine religious practices within their own territory. The Roman Catholic majority was determined to revoke this dangerous concession, and against them the Protestants appealed to the emperor or to a General Council, taking the positive ground of religion. "We protest that in matters which concern the glory of God and the salvation of the souls of each of us, it is our bounden duty, according to God's command, and for the sake of our own consciences, before all things to have respect to the Lord our God. In matters which relate to the glory of God and to the salvation of our souls, we must all stand before God and give account of ourselves." This is the origin of the term 'Protestant'. Protestantism means not only merely negative opposition to the encroachments of the Papacy, but a solemn sense of the responsibility and freedom which are vital to the Christian faith. It implies that in a matter of conscience there can be no final authority of majorities. What was claimed was not absolute freedom for individuals, but that in the last resort every man must answer to God for himself, and every particular Church must have its freedom as a Christian community, uncontrolled by outside authority.

The name of 'Protestant' only established itself slowly. Lutherans and Calvinists preferred their own names at first. But gradually the need of resisting the Roman attack welded them into a common use of 'Protestant' as a unifying title. Its meaning has never altered, but the changes of time have added associations to it which have in some quarters led to a suspicion and even to a rejection of it. (a) Some non-Roman communities insist that as their origin is in the

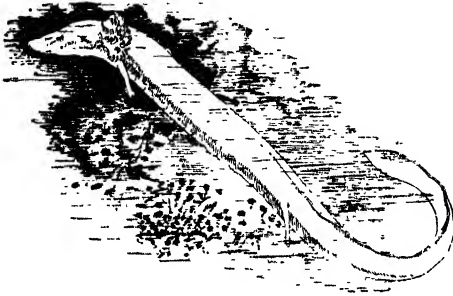
apostolic age, they are inadequately described by a word which emerged in the sixteenth century. (b) Others are repelled by an intractable party which has made 'Protestantism' almost equivalent to a narrow, bitter anti-Roman attitude, especially in politics. (c) Others again, like a party in the English Church, disavow it entirely, "not only as summing up most of the things that they chiefly hate, but even more as linking the Church of England with Churches of Christ which they count no better than unlawful assemblies" (Gwatkin), preferring the vague term 'Catholic'. But 'Protestantism' and 'Catholicism' are not, strictly speaking, antithetical.

The newer investigations into Protestantism are historical rather than doctrinal. They concern its principles as related to those of the mediæval religion. So far as the doctrinal principles are concerned, the recognition is universal; it is the definition that is in debate. Cardinal principles like freedom of judgment and justification by faith are discussed in their essence and application, the disputable point being their theoretical legitimacy and practical efficiency.—BIBLIOGRAPHY: H. Wace, *The Principles of the Reformation*; E. Troeltsch, *Protestantism and Progress*. See bibliography to *Reformation*. The Roman Catholic position is put by J. A. Mochler in his *Symbolism* (1894).

Pro'teus, in Greek mythology, a sea-god who fed the flocks (seals) of Poseidōn (Neptune) in the Ægean Sea. He is represented as a soothsayer who prophesied only when compelled by force and art, and who tried every means to elude those who consulted him, and changed himself, after the manner of the sea-gods, into beasts, trees, and even into fire and water. To those, however, who boldly held him fast he revealed whatever they wished to know, whether past, present, or future. Thus Menelaus surprised him (*Odyssey*, iv, 351), and compelled him to aid him by his prophecies and his counsel. According to other accounts, Proteus was a deified sorcerer of Pallene, a peninsula of Emathia or Macedonia. The later mystics made Proteus an emblem of primeval matter, and he is thus represented in the 24th Orphic hymn. Anyone who hastily changes his principles is, from this old sea-god, called a Proteus, and Shakespeare accordingly gave this name to the fickle lover in *The Two Gentlemen of Verona*.

Proteus (Olm), a genus of tailed amphibia possessing external gills. One species only has been hitherto discovered, namely, the *Proteus anguinus*, which is found in subterranean lakes and caves in Carniola, Carinthia, and Dalmatia. It attains a length of about 1 foot. The body is smooth, naked, and eel-like, the legs four in number, small and weak, the forefeet three-toed,

the hinder four-toed, and, in addition to permanent external gills, it possesses lungs in the form of slender tubes. The places it inhabits being devoid of light the power of vision is unnecessary,



Proteus anguinus

and in point of fact its eyes are rudimentary and covered by the skin. A related form (*Typhlomolge rathbuni*) lives in caves in Texas.

Protococcus, a very simple genus of Green Algæ. *P. viridis* (*Pleurococcus vulgaris*) forms the bulk of the green encrustation found on the windward side of tree trunks, palings, &c. The plant consists of a small spherical cell bounded by a cellulose wall, and containing, besides cytoplasm, a nucleus and a lobed chloroplast. The only method of multiplication is by cell-division, the products of which may hang together in small groups for some time.

Pro'tocol (Gr. *protos*, first, and *kollân*, to glue), originally, in legal instruments the first sheet glued to the *scapus* or cylinder round which the instruments were rolled. The word has since acquired a variety of other significations. In diplomacy it signifies a document serving as a preliminary to, or for the opening of, any diplomatic transaction; also, a diplomatic document or minute of proceedings, signed by friendly powers in order to secure certain political ends peacefully. In Scotland a book was formerly kept under the name of protocol by every notary, for the insertion of copies of all the instruments he might have occasion to draw up.

Pro'togine (-jen), a name given by Jurine to granite in which the mica assumes a talc-like appearance; so called because it was supposed to have been the first-formed granite. It occurs typically in Mont Blanc. It was also called *Talcose-granite*; but the 'talc' proves to be a mica.

Proton. See *Isotopes*; *Electron*; *Matter*.

Pro'toplasm, in biology, the exceedingly complex and very unstable living matter constituting the essential part of all organisms, and described by Huxley as the "physical basis of life". It appears to be a mixture of various substances,

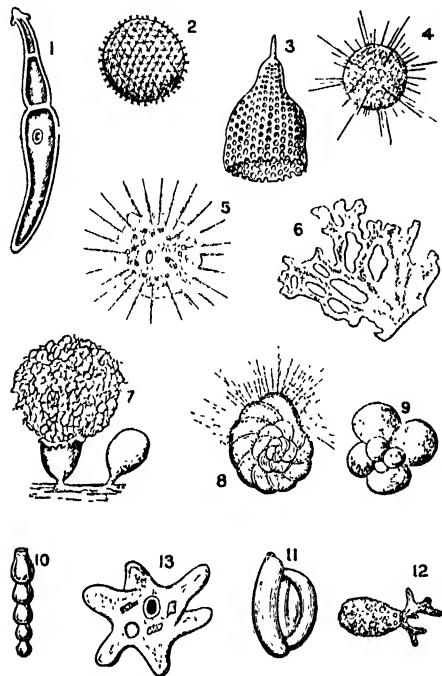
especially proteins, and in ultimate chemical analysis twelve elements are invariably present, i.e. carbon, oxygen, hydrogen, nitrogen, sulphur, phosphorus, chlorine, potassium, sodium, calcium, magnesium, and iron. Protoplasm is semi-fluid, behaves like a liquid, and is of colloid nature. It is constantly breaking down into simpler and simpler substances and as constantly being renewed by the building up of complex substances from those of simpler character. See *Cell*; *Cytology*; *Histology*; *Metabolism*.

Protor'nis, one of the earliest fossil passerine birds. In size and structure it approaches the lark, and it occurs in the Eocene strata of Switzerland.

Protozo'a, the lowest sub-kingdom or phylum of animals, embracing all the unicellular forms, most of which are microscopic. The protoplasmic body may be devoid of investment or definite shape, and capable of flowing out into blunt lobes (*pseudopods*), temporary structures by which creeping is effected. Others are covered by a delicate elastic membrane (*cuticle*), have a definite form, and may possess a small number of lash-like protoplasmic threads (*flagella*) or a large number of short ones (*cilia*), which bend and straighten alternately. Flagella and cilia bring about swimming movements in free forms, while in fixed types they set up currents in the surrounding water by which particles of food are brought within reach. In the more specialized types there is a definite cell-mouth for the ingestion of solid food. Some Protozoa, under unfavourable conditions, can enclose themselves in a horny *cyst*, while in others an encysted stage constitutes part of the life-history. Reproduction is typically by division (fission), but in some cases special asexual cells (spores) are formed. There may also be a temporary or permanent fusion (conjugation), equivalent to sexual reproduction in higher forms. Protozoa are of universal distribution. The great bulk are marine, but some live in fresh water or in damp places on the land, and a number of species have been discovered in the soil. Others, again, are parasitic, and some of these cause diseases, such as malaria, yellow fever, sleeping-sickness, and nagana or fly-disease (of hoofed mammals in tropical Africa). Four classes are recognized. These, with the chief orders which they include, are:

Class I.—**Rhizopoda**. Possess pseudopods, but flagella may be present in early stages. Often become encysted. (1) *Lobosa*, with blunt pseudopods. *Proteus Animalcule* (*Amœba*), common on the surface of mud in ponds; some species are parasitic, causing dysentery. *Arcella*, *Quadrula*, and *Diffugia*, freshwater forms with external shell. (2) *Foraminifera*, with slender

branching pseudopods uniting into networks. A calcareous shell, often of complex nature and elegant form. *Globigerina*, *Orbulina*, *Textularia*, *Nummulina*, &c. (3) Heliozoa, or sun animalcules. Stiff radiating pseudopods. Mostly freshwater forms. *Actinosphaerium* and *Actinophrys* (no shell); *Raphidiophrys* (siliceous spicules); *Clathrulina* (stalked, spherical, perforated, siliceous shell). (4) Radiolaria. Marine



1, Cockroach Gregarine (*Clepsidrina blattarum*). 2, Volvox. 3 and 4, Skeletons of Radiolaria. 5, Sun-animalcule. 6 and 7, Small piece of a Mycetozoon and two capsules (one ruptured) of same. 8, A Foraminifer (*Rotalia*) with protruded threads of protoplasm. 9, 10, 11, Shells of Foraminifera (*Globigerina*, *Nodosaria*, and *Miliola*). 12, Shell-bearing Rhizopod (*Diffugia*) allied to *Amœba*. 13, Proteus Animalcule. See also illustration for Infusoria.

forms, with a central horny capsule and a siliceous shell, which is often complex and beautiful. *Actinomma*, &c. Such shells, often known as Polycystines, abound in Barbados earth, a siliceous deposit.

Class II.—Mycetozoa, Fungus Animals. Relatively large forms living on rotten wood, dead leaves, spent tan, &c. A large number of amoeboid individuals fuse together into a *plasmodium* which creeps slowly over the substance on which it lives. Spores are produced in capsules of various form. Under the name of Myxomycetes (Slime Fungi) these organisms are described as plants by some authorities. *Didymium*, *Badhamia*, &c.

Class III.—Infusoria. Protozoa possessed of flagella or cilia. (1) Flagellata. Provided with flagella. *Heteromita*, *Bodo*, &c., and many other extremely small forms are often known as 'Monads'. *Monosiga*, *Salpingoeca*, *Polyceca* (colonial) are fixed forms, each individual with a single flagellum surrounded by a collar-like expansion. The colonial *Proterospongia* includes individuals of different kinds. *Noctiluca* is relatively large, and is one of the organisms causing the phosphorescence of the sea. Forms containing chlorophyll, and regarded as plants by some authorities, are *Hæmatococcus*, *Pandorina* (colonial), and *Volvox* (colonial). (2) Ciliata. Provided with cilia. Slipper Animalcule (*Paramecium*), *Stentor*, Bell Animalcule (*Vorticella*) with a contractile stalk, and related colonial forms, *Acineta* (with pointed processes for extracting the juices of other animals).

Class IV.—Sporozoa. Parasitic Protozoa, many of which are exceedingly small. Life-history complex. Some are the causes of grave diseases. Malarial parasites (*Plasmodium*, &c.) introduced into the blood by mosquitoes. Sleeping-sickness and nagana parasites (*Trypanosoma*) disseminated by tse-tse flies.

Protractor, an instrument for measuring angles. The simple type such as is used by draughtsmen is made of box wood, celluloid, bone, or metal in the form of a disc or a rectangle, and marked with radial lines from a point. It has a scale which shows the number of degrees between the lines and a common base. In another form the device is made in two parts, one of which takes the form of an arm or disc which can be turned relative to the other so that lines on each can be superposed on those subtending the angle to be measured. When made in this way a vernier may be fitted to subdivide the divisions of the scale. Protractors of the second type are commonly fitted to surveying instruments.

Proudhon (prô-dôn), Pierre Joseph, French socialist and political writer, born at Besançon 1809, died there 1865. The son of poor parents, he was enabled to attend gratuitously the college of his native town. At the age of nineteen he entered a printer's office, afterwards became a press reader, and in this way acquired considerable linguistic knowledge, with the result that he wrote an *Essai de grammaire générale*. As a reward for his studious labours he had conferred on him by the Academy of Besançon the *pension Suard*, which yielded him an income of 1500 francs for three years. Political economy now became his chief study, and in 1840 appeared his famous work, bearing on the title-page the question: *Qu'est-ce que la Propriété?* (What is Property?), to which the first page of the treatise contains the answer, 'C'est le Vol' (it is theft). The principal theses maintained by him in this

work are that labour is the sole just ground of individual possession, and that all labour ought to be rewarded equally. For this treatise, and two others which followed, he was prosecuted at Besançon, but was ultimately acquitted. The jury returned a verdict in this form: This man is in a sphere of ideas inaccessible to the vulgar; we cannot condemn him at random; and who will answer for his culpability? In 1843 he managed a system of water transport on the Rhône and Saône; settled in Paris in 1847; started various newspapers, and became a leader in the Revolution of 1848; was elected a representative for the Seine in the Constituent Assembly; attempted with no success to found a Banque du Peuple; and for his outspokenness in the press he was imprisoned for three years. Besides those already noticed, his more important treatises are: *Discours sur la célébration du dimanche*, *De la création de l'ordre dans l'humanité*, and *Système des contradictions économiques*.—Cf. Desjardins, P. J. Proudhon: *sa vie, ses œuvres, et sa doctrine*.

Prout, Samuel, British painter, born in Plymouth 1783, died 1852. He received a few lessons in drawing in his native town, and prosecuted his work by industriously sketching from nature. In 1812 he settled in London, was an occasional exhibitor at the Academy and British Institution, and was elected a member of the Society of Painters in Water-colours in 1820. He became famous for his drawings of street scenes and the quaint mediæval architecture of Europe. Some of his sea-coast scenes exhibit great power.

Provençal Language and Literature, strictly the language and literature of that portion of Southern France known as Provence, but in its widest application the Provençal language includes the Romance form of speech belonging to the inhabitants of a geographical area which comprises the whole south of France (especially Provence, Limousin, Auvergne), with Catalonia and Valencia in Spain. This language was the earliest cultivated of the Romance languages (or those based on the Latin), and at one time was extensively used in literature. It was also called *langue d'oc* in contradistinction to the kindred speech of Northern France, the *langue d'oïl*; and yet again it received the name of *lingua lemosina* from the region where it was spoken with the greatest purity. Southern France, already refined by colonies from Greece, and by its vicinity to the Romans, favoured with a milder climate and a freer government, was until the eleventh century far in advance of the north in civilization, and its language was distinguished for clearness, tenderness, sweetness, and copiousness. The language, and the cultivation acquired through the intercourse with the

East, particularly with the poetical Arabs, awakened imagination and contributed to foster genius and to produce poetry. The taste for poetry was general among the nobles and cultivated classes in Provence, and the princes, particularly Raymond Berengarius III (1168–81) and IV (1209–45), favoured the poetical art. Courtesy and gallantry were nowhere so fully developed as in Provence, and the court became the centre of a romantic life. The life of the Provençals was lyrical in the highest degree, and their poetry, the expression of their feelings and passions, necessarily lyrical. Provençal, as a new and distinct language, appears in historical records about the tenth century, and continued as a medium of living literary expression until about the end of the thirteenth century. Provençal is a language whose interest as a vehicle of literature is mainly in the past. This interest begins in the early part of the eleventh century with a didactic poem, based by its unknown author on the *De Consolatione Philosophiæ* of Boethius; but Provençal literature in its development found most characteristic expression in the amorous lyrics of the troubadours. The earliest of these lyric poets was William IX, Count of Poitiers, about the close of the eleventh century, who was followed in France, Italy, and Spain by an innumerable band of poets in the Provençal tongue. Most of this poetry was intended to be sung, and not infrequently the poet also composed his own music. Besides the lyric poetry, of which there were various classes, Provençal poetry also existed of a narrative character, in which legendary and historical themes were treated in epic detail. The rapid decay of this Provençal literature, which was almost exclusively the possession of the upper classes, was largely due to political causes. During the war with the Albigenses the social condition of the feudal nobility in the south of France suffered such downfall that thenceforth the art of the troubadour and the minstrel ceased to be adequately remunerated. In 1350 a few scholars of Toulouse attempted to revive its decaying glory, and for this purpose composed a treatise on grammar and poetry called the *Leys d'Amors*. About the middle of the fifteenth century the language ceased to be used both for administrative and literary purposes, and it has long been reduced almost to the condition of a *patois*. In the nineteenth century a new revival took place, under the impulse of such poets as Jacques Jasmin and Frédéric Mistral, who endeavoured to resuscitate Provençal as a literary language, and produced poems of no small value written in the modern form of it. A society of literary men and scholars (*lou Felibrige*) was founded for the purpose of furthering this object. See *Troubadour*.—BIBLIOGRAPHY: F. Mistral, *Lou*

Tresor dou Felibrige; A. Dauzat, *Phonétique historique du patois de Vinzelles*; Mariéton, *La Terre provençale*; Mary-Lafon, *Histoire littéraire du midi de la France*; J. de Nostredame, *Les vies des plus célèbres et anciens poètes provençaux*.

Provence (pro-vāns), one of the old provinces of France, lying in the south-eastern part of the country, on the Mediterranean, bounded on the north by Dauphiné and Venaissin, on the east by Piedmont, and on the west by Languedoc. It now forms the departments of Bouches-du-Rhône, Var, and Basses-Alpes, with parts of Vaucluse and Alpes-Maritimes. The capital was Aix, and the province was divided into Upper and Lower Provence. Greek colonies were founded here at an early period; and the Romans, having conquered all the south-east of Gaul (124–123 B.C.), gave it the name of *Provincia Gallia*, or simply *Provincia* (the province), whence its later name was derived. It passed successively into the hands of the Visigoths, Ostrogoths, Franks, and in 879 became part of the Kingdom of Burgundy. It subsequently was ruled by the Counts of Arles and the Counts of Barcelona, then by Charles of Anjou (brother of Louis IX of France) and his descendants, and in 1481 passed to Louis XI of France.—Cf. A. Fabre, *Histoire de Provence* (4 vols.).

Proverb, a short pithy sentence forming a popular saying and expressing, in a keen, quaint, or lively fashion, some result of the experience of life. Proverbs are the flower of popular wit and the treasures of popular wisdom. They give the result of experience in a form made impressive by rhyme, alliteration, parallelism, a pointed turn, or a comparison drawn from the most ordinary scenes and occurrences of life, which, by the force of association, makes their effect strong and permanent. Proverbs are plain-spoken. They may be unassuming, lively, grave, or even sublime; their general character is *naïveté*. In their view, as in the eye of the law, all are equal. They take cognizance of the virtues and vices and follies of all classes, without respect of persons. They pierce the object at which they aim, and this in fact gives them currency, and makes them what they are. Proverbs have been defined by Cervantes as "short sentences drawn from long experiences"; by Howell as sayings which combine "sense, shortness and salt"; by Bacon as "the genius, wit, and spirit of a nation"; and by Earl Russell as "the wisdom of many, and the wit of one". They have formed an important part of the common wisdom of both Eastern and Western civilizations, and in this way they are interesting in a study of the spread and structure of language, as it has been pointedly applied to changing manners and customs. Greek and Latin proverbs were collected by Erasmus in

his *Adagia*; English proverbs have been collected by Camden, Howell, Ray, Kelly, Bohn (an enlarged and improved edition of Ray), and Hazlitt; Scottish by Allan Ramsay and by A. Hishop; French by De Linsey; German by various collectors, more especially Wander; Arabic by Burckhardt and by Freytag; Bengali by Long.—**BIBLIOGRAPHY**: R. C. Trench, *Proverbs and their Lessons*; Bohn's *Polyglot of Foreign Proverbs*; G. Strafforello, *La Sapienza del Mondo*.

Proverbs, The Book of, in the Hebrew Canon of Scripture, is included in the *Hagiographa*, and comes immediately after *Psalms*. The structure of the work is composite, being a compilation of miscellaneous aphorisms, counsels, and sententious dicta of the sages dealing with conduct, character, and the general management of life. The thought, placid and genial throughout, never ventures from the realm of practical ethics into the sphere of speculation and metaphysics. Common sense characterizes the whole collection as befitting a popular anthology of wise maxims and moral discourses.

The authorship of the book cannot be attributed to any one mind. Tradition was in favour of King Solomon, who, it is reported (*I Kings*, iv, 32), "spoke three thousand parables". Certain sections of the book (i–ix; x–xxii, 16; xxv–xxix), according to the editorial headings, profess to be Solomonic. But it is now the opinion of most scholars that the earliest section (x–xxii, 16) implies a date after the Exile. Although many individual proverbs are even earlier than the times of the monarchy, we have no proof that any of the wise king's reputed proverbs have been preserved. King Solomon, in the eyes of posterity, was regarded as the grand master of proverbial lore, just as his father David was regarded as the founder of psalmody. Hence the work was circulated under the authority of the royal name.

Internal evidence, however, reveals the successive layers of redaction. The following divisions are distinguishable:

1. *Introductory group of discourses* (i–ix), with the heading "The Proverbs of Solomon", &c.
2. *Nucleus* (x–xxii, 16), "The Proverbs of Solomon".
3. *Two smaller collections of aphorisms* (xxii, 17–xxiv, 22, and xxiv, 23–34, the latter section having as heading, "These also are by the wise").
4. *Hezekian collection* (xxv–xxix), so called from the heading, "These are also proverbs of Solomon which the men of Hezekiah, king of Judah, copied out".
5. "The words of Agur" (xxx).
6. "The words of King Lemuel" (xxx, 1–9).
7. *Acrostic poem of the virtuous woman* (xxx, 10–31).

In the Greek version there is a dislocation of

the sections, thus further substantiating the view that they were originally separate tracts.

Although there is lack of continuity in the parts, nevertheless one sustained theme unites the various sections into coherence. The dominant chord is *wisdom*. The prefatory couplets (1, 2-7), perhaps the work of the final editor, explain the *raison d'être* of the whole collection, namely, that men may be exercised in wisdom, which, as we shall see, is more than merely worldly wisdom, from which the book is not altogether free. In the opinion of the sages, wisdom is that which governs and regulates human action, in fact, it is equivalent to religion. "The fear of the Lord is the beginning of wisdom." Wisdom was a spacious term for knowledge of God and knowledge of man. It was this association of worldly knowledge with divine knowledge that made the teaching of the sages so popular. Nothing human was alien to them since it partook of the nature of God. They were the humanists of Israel, and the freedom from bias and the breadth of outlook which this conception of wisdom indicates were largely due to the influence of the Greek spirit of emancipation.

In *Proverbs* the existence of one God is assumed. The law, the temple, and the priesthood are nowhere mentioned. Indeed, in tone and character there is a complete absence of national feeling in the book. The general inference is that *Proverbs* dates after the Exile, say about 300 B.C.

St. Paul quotes about twenty times from *Proverbs*, while with the early Fathers it was a special favourite. Indeed, wherever was to be found "pure religion breathing household laws", there it was chosen as the authorized manual of conduct. "Concise sentences," says Bacon, "like darts, fly abroad and make impressions, while long discourses are flat things, and not regarded"—hence the value and effectiveness of the book and the general esteem in which it has been held by past generations.—BIBLIOGRAPHY: C. H. Toy, *Proverbs*; J. J. S. Perowne, *Book of Psalms*.

Providence, a city and port of entry of the United States, the capital of the state of Rhode Island and the county seat of Providence county; served by the New York, New Haven, & Hartford Railway, and by coasting-steamers to New York, &c. In the centre of the city the river expands into a circular sheet of water called the Cove, nearly a mile in circumference. The principal buildings are the state capitol, city hall, public library, court-house, and Brown University (founded 1764), which is under Baptist control. The principal manufactures are jewellery, worsted goods, silver ware, steam-engines, rubber and elastic goods, cotton and woollen goods, and margarine. There is a safe and commodious harbour, though somewhat difficult of access,

and the coasting trade is important. Providence was first settled in 1636, incorporated in 1649, and became a city in 1832. Pop. (1920), 237,595.—BIBLIOGRAPHY: W. R. Staples, *Annals of the Town of Providence*; W. Kirk, *A Modern City: Providence, Rhode Island and its Activities*.

Province, originally a country of considerable extent, which being reduced under Roman dominion was remodelled, subjected to the command of a governor sent from Rome, and to such taxes and contributions as the Romans saw fit to impose. In modern times the term has been applied to colonies or to independent countries at a distance from the metropolis, or to the different divisions of the kingdom itself. Thus the Low Countries belonging to Austria and Spain were styled *provinces*. The different governments into which France was divided previous to the Revolution were also called provinces. The name has sometimes been retained by independent states. Thus the Republic of Holland, after it had thrown off the Spanish yoke, was called the United Provinces. The main divisions of India and the Dominion of Canada are known as provinces. In the canon law the term is applied to the jurisdiction of an archbishop. In the Roman Catholic Church it is also given to the territorial divisions of an ecclesiastical order such as the Franciscans.

Provins (pro-van), a town of France, in the department of Seine-et-Marne. It has interesting historical and architectural relics. Provins is mentioned in a capitulary of Charlemagne in 802, and in the thirteenth century it was a large and important city. It derives its modern reputation from its mineral-waters, used for bathing and drinking, and from the roses which are cultivated in the district. Pop. 9000.

Provost, a title given to the president of certain bodies, as the heads of Oriel, Queen's, and Worcester Colleges at Oxford, and of King's College, Cambridge, equivalent to the *Master* in other colleges. In the cities and burghs of Scotland the provost is the chief magistrate, corresponding to the English mayor. The chief magistrates of Edinburgh and Glasgow are styled *lord provost*, and the same title has been granted to, or is popularly given to, several others.

Provost-marshal, the title now borne by the commandants of the Corps of Military Police, who with two assistants are permanent officials. In addition to these, certain regimental officers with the title of deputy, assistant, or deputy-assistant provost-marshal are in peace-time temporarily attached to the Military Police for service with detachments of the corps at the head-quarters of certain commands and large formations. The duties of provost-marshals of all grades are to keep order among the troops

of a garrison town when such troops are for the moment not under the immediate control of their own officers, e.g. when men are at liberty in a town. On mobilization a provost-marshal and as many assistants as may be necessary are appointed pursuant to the provisions of Section 74 of the Army Act, which reads as follows: "For the prompt repression of all offences which may be committed abroad provost-marshals with assistants may from time to time be appointed by the general order of the general officer commanding a body of forces. A provost-marshal or his assistants may at any time arrest and detain for trial persons subject to military law committing offences, and may also carry into execution any punishment to be inflicted in pursuance of a court-martial, but shall not inflict any punishment on his or their own authority."

In earlier days a provost-marshal, according to Grose (*Military Antiquities*), was a sort of man-of-all-work to the camp, and appears to have been responsible for many duties.

Proxy (contracted from *procuracy*), the agency of another who acts as a substitute for his principal. In parliamentary law every member of the House of Lords could formerly (until 1868) constitute another member of the House of the same order with himself his proxy to vote for him in his absence. Shareholders of a company can vote by proxy.

Prudentius, Aurelius Clemens, one of the early Christian poets, born at Calagurris, in Spain, in A.D. 348, died after the beginning of the fifth century. In his latter years he composed a great number of hymns and other religious poems in which he successfully imitated classical models.

Prudhon (prü-dōn), Pierre, French painter, born in 1758, died in 1823. He studied his art at Dijon and in Rome, where he came under the influence of Correggio and of Leonardo. In 1789 he settled in Paris, where he gradually made his way, and at length became famous by his *Truth descending from Heaven*, *Psyche carried off by Zephyr*, and *Crime pursued by Justice and Divine Vengeance*. His importance consists in the fact that, in opposition to David, he accentuated the purely pictorial element and the effect of light in his works.

Prunella, or **Prunello**, defined by Skeat as a strong, woollen stuff, originally dark in colour. It was once used for clergymen's gowns, and is still used for the uppers of ladies' boots and shoes. A weave often used for a kind of woollen cloth is called the prunelle twill. The word is mainly remembered on account of Pope's couplet (*Essay on Man*, iv, 204):

Worth makes the man, and want of it, the fellow,
The rest is all but leather or prunella.

Pruning is the severing of portions of the stem, branches, shoots, leaves, or roots of a plant for the purpose of removing excrescent or unprofitable growths, and rendering the sap more conducive to the nutrition of the valuable parts of the plant. The immediate effect of pruning is to reduce the growth of a plant in as far as it depends on the amount of foliage duly exposed to the light; but as by judicious pruning the parts left have not only a greater share of sap, but are better exposed to the light, its ultimate effect is to produce a larger and stronger plant. From the tendency of sap to flow in increased quantity into the parts immediately adjoining those where its flow has been interrupted, an almost unlimited power is given to the gardener of controlling the direction of the growth of a plant. The season for pruning varies with the nature of the tree and the purpose for which it is pruned. In general it may be said that autumn or winter is the best season for extensive pruning; in summer an excess of vigour in the plant may require a little pruning, but in spring it not only weakens the plant, but is liable to induce disease. *Root-pruning* is employed to check rapidity of growth and to induce development of flower-buds. The best season for this operation is after the leaves have fallen in autumn or before the sap begins to flow in spring.

Prunus, a genus of arborescent plants belonging to the nat. ord. Rosaceæ, and comprehending the cherry, bird-cherry, plum, damson, sloe, bullace, apricot, &c.

Prurigo is the name applied to a papular eruption with intense itching. Like other affections with severe itching, it is often complicated by septic and eczematous conditions as a result of scratching. There are various forms of prurigo; the commonest is strophulus or gum rash.

Prussia, a republic of Germany, the largest component state of the German Reich. It is divided into provinces which, with areas and populations, past and present, are shown in the table on the following page. By a comparison of these figures it will be seen that, on the basis of the census of 1910, Prussia has lost by the Treaty of Versailles 20,798 sq. miles of territory and a population of 3,089,979. The population is now less than at the census of 1905, but the density per square mile is greater than at any previous period in Prussia's history.

Physical.—Prussia belongs to the great plain of Northern Europe, and may be described generally as a vast plain, elevated in the south and south-west, and thence descending towards the Baltic and the North Sea, on both of which it comprises almost the whole coastal plain of Germany. The Rhine, Elbe, Oder, and Weser are the principal rivers.

Provinces. ¹	Pre-European War.			Post-European War.		
	Area, sq. Miles.	Pop. 1910.	Pop. per sq. Mile, 1910.	Area, sq. Miles, 1920.	Pop. 1919.	Pop. per sq. Mile, 1919.
East Prussia (Ostpreussen)	14,320	2,064,175	144.1	14,286	2,229,290	156.0
West Prussia (Westpreussen)	9,863	1,703,474	172.7	3,026 ²	326,881	108.0
Berlin	24	2,071,257	86279.0	338	3,803,770	11253.8
Pomerania (Pommern)	11,620	1,716,921	147.6	11,654	1,787,193	153.4
Brandenburg	15,376	4,092,616	266.1	15,070	2,445,627	162.3
Posen	11,190	2,099,831	187.6	—	—	—
Silesia (Schlesien)	15,560	5,225,962	335.6	—	—	—
Saxony (Sachsen)	9,752	3,080,275	315.7	9,756	3,129,193	320.7
Schleswig-Holstein ³	7,340	1,621,004	220.8	5,805	1,462,187	251.9
Hanover (Hannover)	14,862	2,942,436	197.9	14,860	3,017,366	202.9
Westphalia (Westfalen)	7,804	4,125,096	528.6	7,807	4,488,115	574.9
Hesse-Nassau	6,060	2,221,021	366.5	6,062	2,273,502	375.0
Rhine (Rheinprovinz)	10,420	7,121,140	683.4	9,470	6,769,460 ⁴	714.8
Hohenzollern (Hohen-Zollernsche Lande) ..	441	71,011	141.0	441	70,751	160.4
Lower Silesia (Niederschlesien)	—	—	—	10,270	2,987,904	290.9
Upper Silesia (Oberschlesien)	—	—	—	4,998	2,283,992	457.0
Total	134,650	40,165,219	298.2	113,852	37,075,240	325.6

¹ All of these are dealt with under their respective titles elsewhere in this work.

² Border Province.

³ Including Helgoland; pop. (1910), 3027, exclusive of military.

⁴ This figure includes the Saar but not Eupen and Malmédy. These figures may not be exactly in agreement with those of other statistical tables, but in compilation preference has been given to the figures quoted in the 1922 edition of Brockhaus, *Handbuch des Wissens* (vol. 1).

Towns.—The capital is Berlin; others are: Köln (Cologne, pop. 633,900), Breslau (528,260), Essen (440,000), Frankfurt-am-Main (433,000), Düsseldorf (407,340), Hannover (400,000), Dortmund (300,000), Magdeburg (286,000), Königsberg (260,900), Duisburg (244,300), Stettin (233,000), Kiel (205,300), Halle (182,400), Altona (170,000), Cassel (163,000), and Elberfeld (160,000).

Government.—Prussia was proclaimed a republic on 13th Nov., 1918, and a new Constitution was adopted on 30th Nov., 1920. This provides for a Diet (*Landtag*) which elects a Premier, who, in his turn, appoints responsible ministers to the portfolios of National Welfare, Justice, Commerce, Interior, Agriculture, Finance, and Education and Public Worship. These ministers, with the Premier, form the Cabinet, and are vested with the powers of the former king. The Diet is elected for four years on the principle of proportional representation and by universal male and female suffrage, the age qualification being twenty years. The State Council or *Staatsrat* (74 members) advises and controls the Diet, and has the power of veto over legislation approved by the Diet. The deliberative assemblies of the provinces elect the Council on a basis of one representative to 50,000 inhabitants. Each province is controlled by a Governor (*Oberpräsident*), superior to the presidents of districts, and there is a limited measure of local government. Prussia sends 26 members to the German Imperial Council (*Reichsrat*), as compared with 10 from Bavaria, 4 from Württemberg,

7 from Saxony, 3 from Baden, and 16 from the other states.

Religion.—About two-thirds of the population are Protestants and one-third are Roman Catholics, with a small number of Jews and unclassified religions.

Education.—Elementary education is free and compulsory from six to fourteen years, but secondary instruction is entirely voluntary. There are 13 universities, 356 gymnasia, 507 lyceums (girls' high schools), 38,684 public elementary schools, 204 public normal schools, 2 forestry schools, 2 technical mining schools, 2 agricultural colleges, 2 veterinary colleges, 4 commercial academies, and 4 technical high schools.

Production and Industry, &c., are dealt with under the respective provinces.

BIBLIOGRAPHY: S. Osborne, *The Upper Silesian Question and Germany's Coal Problem*; *Germany (Peace Handbook)*, vol. vii, H.M. Stationery Office).

History.—The historical development of Prussia is closely associated with three important elements. The first of these is found in the growth of the power of the Electorate of Brandenburg, which formed the nucleus of the future state; the second relates to the acquirement of the province of Prussia, which gave its name to the new heterogeneous territory; and the third is associated with the rule of the Hohenzollern family, under whose skilful diplomatic and military guidance the small Brandenburg electorate grew into what is now considerably the larger portion of the German Reich. Branden-

burg, which had been conquered by Charlemagne in 789, was erected into a margraviate by Henry I (the Fowler), Emperor of Germany in 926. Albert the Bear, who received Brandenburg as a fief from the Emperor Lothaire II (1134), conquered the Slavonian Wends, and took in 1157 the title of Margrave of Brandenburg. His dynasty continued to rule till 1320, and during this period German civilization was gradually extended in Pomerania, Saxony, Brandenburg, and Silesia. After its extinction there followed a period of anarchy, during which Brandenburg fell as a lapsed fief to the empire, and Louis of Bavaria gave it to his son. Remaining under Bavarian rule for three electorates, it was subsequently ceded to the House of Luxemburg, and Charles IV, the first imperial representative of this House, gave it successively to his sons Wenceslas (1373) and Sigismund (1378). The latter, being in debt, received from Frederick, the Burgrave of Nürnberg, a loan of 400,000 gold florins, for which Frederick held Brandenburg in pawn, and subsequently acquired it in full. This burgrave was the descendant of Conrad of Hohenzollern, a cadet of a Sualbian family to whom belonged a small territory surrounding the ancestral castle of Hohenzollern, of which they traced their lordship back to the time of Charlemagne. Brandenburg, which Frederick had thus acquired, was covered with feudal strongholds, which he gradually reduced, and he also added the two small territories of Ansbach and Baireuth. Frederick II, who succeeded his father in 1440, extended the possessions of his family by policy as well as by valour. In 1470 he abdicated in favour of his brother Albert III, surnamed Achilles, who, by a family ordinance, prepared the way in an important respect for the future greatness of his House by providing for the undivided descent of the dominions in connection with the electorate (*Dispositio Achillea*). In 1618 John Sigismund united the Duchy of Prussia to the electorate, and the whole country became known as Prussia.

In 1614, by the Treaty of Xanten, Clèves and La Marck were assigned to Brandenburg, and the foundations of the Prussian Rhine-province were thus laid. During the Thirty Years' War (1618-48) the electorate suffered severely, but the power of modern Prussia was consolidated during the second half of the seventeenth century. Frederick William (1640-88), called the Great Elector, may be regarded as the virtual founder of the Prussian monarchy. He was succeeded by his son Frederick, who in 1701 had himself crowned as king, being the first King of Prussia. Under his rule the Prussian troops fought side by side with the English at Blenheim, Ramillies, Oudenarde, and Malplaquet. Frederick I was succeeded by his son (1713)

Frederick William I, who governed Prussia till 1740. At his death he left a prosperous country, a well-supplied Treasury, and an army of 80,000 men to his successor.

Frederick II, surnamed the Great (q.v.), succeeded to the crown on the death of his father in 1740. He wrested Silesia from Austria, and by the partition of Poland (1772) added West Prussia to his kingdom. At his death in 1786 Frederick II left Prussia a European power. He was succeeded by his nephew Frederick William II (1786-97), during whose reign the partition of Poland was completed. Frederick William II was succeeded by his son Frederick William III (1797-1840). Continuing his father's policy in regard to France, the new king courted the French directorate, and at the Peace of Lunéville (1801) Prussia was indemnified by 4116 sq. miles ceded at the expense of the empire. In 1804 Prussia recognized Napoleon as Emperor of France, and in the campaign which ended in the overthrow of Austria at Austerlitz (1805) remained neutral. This attitude was at first successful, but ultimately it led to distrust among the German states, and by the formation of the Confederation of the Rhine, Prussia was isolated and left to the mercy of Napoleon. At the instigation of the latter Prussia had occupied Hanover, but Napoleon treated this fact with contemptuous indifference when he offered to restore Hanover to England. In his indignation at this insult Frederick William declared war against France without an ally. The result was the battle of Jena and Prussia's defeat. At the Peace of Tilsit (June, 1807), concluded between Prussia and Napoleon, all lands between the Rhine and the Elbe were ceded to Napoleon for his free disposal, a war indemnity of 140,000,000 francs was imposed on the mutilated kingdom, and Frederick William was also under treaty obligation not to maintain an army of more than 42,000 regular troops during the next ten years. The years which followed this national disaster were chiefly remarkable for the sweeping internal reforms which the crisis necessitated, carried out under Baron Stein and Baron Hardenberg, and almost amounting to a revolution. In the great struggle for the overthrow of Napoleon which followed, an important part was taken by the Kingdom of Prussia, and the Prussian troops along with the British bore a noble part in the Waterloo struggle. At the Congress of Vienna (1815), when the map of Europe was rearranged, Prussia, though losing some possessions, was indemnified with others more extensive and valuable, and was placed in a more advantageous position than before. She now also formed one of the states in the new German Confederation.

After the Restoration Frederick William III leaned to the despotic counsels of Austria and Russia, supported heartily the Holy Alliance, and entered upon a reactionary policy which continued until his death in 1840. He was succeeded by Frederick William IV, who was expected to grant a Constitution to his subjects, but refused the demand of his states to this effect in 1841. In 1847 he tried to anticipate the revolutionary movement spreading throughout Europe by summoning a combined meeting of provincial Parliaments at Berlin, but he conferred on them no real power. In the following year, however, after a deadly struggle, in which Berlin was declared in a state of siege, the king dismissed his ministers, and granted a Constitution, the details of which were elaborated by a new Parliament, and which was formally proclaimed in 1850. The Poles in 1848 revolted against Prussian rule, but the movement was summarily suppressed. In 1848 a deputation of the German National Assembly at Frankfurt offered the crown of Emperor of the Germans to the King of Prussia, but it was declined. By this time two parties existed in the Germanic Confederacy, one of them desiring Prussia to be the chief state in Germany, to the exclusion of Austria altogether; henceforth there was a strong rivalry between these two states. In 1857, the king being insane and unable to conduct affairs, his brother William became regent, and ultimately succeeded to the throne on the death of Frederick William in 1861.

The new king, William I (1861-88), showed a disposition to absolutism, which in 1862-3 occasioned a lengthened dispute between the chambers and the ministry under Count Bismarck. At this time, on the complaint of the Federal Diet that Denmark had not observed its treaty obligations in regard to the Duchies of Schleswig and Holstein, the Prussians, under General Wrangel, entered Schleswig (1864), and Denmark was overpowered. By the Treaty of Vienna, signed 30th Oct., 1864, Denmark gave up Schleswig, Holstein, part of Jutland, and Lauenburg to Germany. In the following year Prussia purchased the claims of Austria over the Duchy of Lauenburg, and it was agreed that Schleswig and Holstein should be administered separately by both powers. But this settlement did not last long. Prussia, which had determined on appropriating them, wished to buy out Austria, but the latter would not cede her claims for money. This led to war between the two powers and to the break-up of the German Confederation, some of the states of which sided with Prussia, others with Austria. On 15th June, 1866, the Prussian troops took the offensive, and the brief campaign which ensued is known as the Seven Weeks' War.

The Prussian forces were armed with the new needle-gun, and the entire operations were directed by the chief of staff, Count von Moltke. The Austrians, under General Benedek, were completely defeated near Königgrätz, in Bohemia, where on 3rd July was fought the decisive battle of Sadowa; and peace soon followed. A subordinate campaign against Hanover, Bavaria, and other states had been conducted by the Prussians with complete success. After the war Prussia incorporated Hanover, Hesse-Cassel, Nassau, Hesse-Homburg, Schleswig, Holstein, Lauenburg, Hesse-Darmstadt north of the Main, and the principality of Hohenzollern, which already belonged to the royal family. The King of Prussia now invited the states of North Germany to form a new confederation, which was established on the basis of proposals made by Prussia. The jealousy of France was excited by this powerful confederation, and in 1867 the question of the disposal of Luxemburg brought France and Prussia almost to the point of war. In 1870 Prince Leopold of Hohenzollern consented to become a candidate for the then vacant Spanish throne. This was opposed by the French emperor (Napoleon III), who demanded not only that the candidate should withdraw, but that the King of Prussia should pledge himself not to permit any such future candidature. This being refused, war was declared by France on 15th July, 1870, with a most disastrous result to herself. After the German arms had proved entirely successful, on the invitation of the North German Parliament supported by the South German states, the King of Prussia assumed on 18th Jan., 1871, the title of German Emperor.

From this point the history of Prussia is, to a great extent, merged in that of the German Empire. In the hands of Prince Bismarck, acting as Premier of Prussia as well as Chancellor of the empire, a strong, central, autocratic government was maintained. Externally his policy was to secure Germany from attack by France or Russia, and to bring about this, alliances were made with Austria and Italy. Internally the legislation of Prussia was for some time chiefly remarkable for its antagonism to the Roman Catholic Clerical and Socialist parties. In 1873 many clerical privileges were suppressed by the laws introduced and carried by Falk; but in 1880 an amendment to these was promoted by the Premier, and subsequently he greatly modified his opposition to the ultramontanans. The Social Democrats also evoked the special antipathy of the Prussian Premier, and their success at the elections, especially in Berlin, caused him to promote an anti-social law, which was vigorously applied. In his policy, both home and foreign, Prince Bismarck was supported by the

Emperor William I until the death of the latter in March, 1888. He was succeeded by his son Frederick III, who, when he ascended the throne, was struggling with a deadly throat disease. When he died in June, 1888, he was succeeded by his son William II (1888-1918), who showed himself a ruler with a mind and will of his own. He dismissed Bismarck (1890) and inaugurated a world-policy, which soon proved to be a menace to European peace. See *Germany*; *European War*.

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Prussia, East (Ostpreussen), a detached maritime province of Prussia, Germany, lying along the Baltic coast between the districts of Danzig and Memel, and conterminous elsewhere with Poland (south and west) and Lithuania (east).

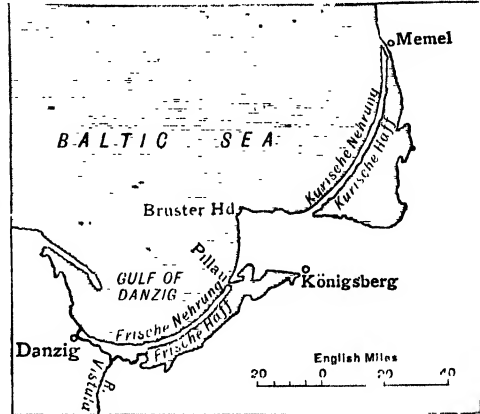
Area, &c.—East Prussia has an area of 14,286 sq. miles, and, after West Prussia, it is the most thinly populated province of the Republic. There are no really large towns, and only one, Königsberg, the chief town (pop. 1919, 260,895), has any considerable industrial population. Other towns are Tilsit (40,000), Insterburg (30,000), Elbing (63,000), and Allenstein (30,000). Roughly, 66 to 68 per cent of the people are country-dwellers, and are devoted to agriculture and rural pursuits.

The following table shows the intercensal increases in population:

1816.		1871.		1910.		1919.	
Total.	Per sq. Mile.	Total.	Per sq. Mile.	Total.	Per sq. Mile.	Total.	Per sq. Mile.
886,174	62	1,822,934	127	2,064,175	144	2,229,290	156

Physiography.—The coast in general is flat, and is occupied by the Frisches and Kurisches Haff. The water is shallow and tidal action is negligible. The surface is studded with innumerable lakes, varying from mere ponds to large sheets of water like the Spirding See and Mauer See, which have areas of 45 and 50 sq. miles respectively. The province may be divided into three physiographical areas: (1) the lowland, forming the northern half of the province; (2) the Prussian ridge, occupying the southern half; and (3) the Vistula depression in the west, which separates the Prussian ridge from the

Pomeranian ridge. In the East Prussian lowland there are three areas of higher land which stand out from the rest of the country, viz. (1) the Elbinger Höhe, east of Elbing; (2) a group of hills south of a line from Heiligenbeil (on the Frisches Haff) to Deutsch Eylau; and (3)



Coast of East Prussia, showing the Haffs (Lakes) behind the Storm Beaches

Samland, in the vicinity of Königsberg. The remainder of the country slopes gently towards the rivers and the sea, and is almost entirely below 300 feet in height. The most fertile areas are in the Vistula depression and delta-plain, and in Samland. Sand movements on the Nehrungen, the surfaces of which rise from the sea to form dunes opposite the Haffs, have been checked by the planting of pines. The western frontier is traversed by the Vistula (q.v.) and

its tributary the Nogat, which has a fall of 1 in 7299, and a breadth of 130 yards, and falls into the Frisches Haff. The Memel (Russ. *Niemen*) forms a part of the eastern frontier-line. It enters East Prussia at Schmallingken, 70 miles from the sea, after flowing 480 miles through Russia, Poland, and Lithuania, and branches at Kallwen to form a delta which has, in course of time, filled up between one-third and one-half of the Kurisches Haff. The main stream is called the *Russ* from Kallwen to its mouth, and its average fall is 1 in 12,223, the greatest being 1 in 8312. The Pregel and its tributaries drain the eastern

and central areas of the province, the main stream being formed by the junction of the Inster and the Angeraph (with its affluent the Pissa) at Insterburg, and flowing into the Frisches Haff $4\frac{1}{2}$ miles west of Königsberg. It emerges again at the Pillau Deep (the Pregel). East Prussia has an average temperature of between 41° and 43° F. January is the coldest month, the mean temperature being then about 28° F. July is the warmest month, and 63° F. may then be attained. East Prussia is, then, the coldest province of Germany. The rainfall is moderate, and being just within the Continental area, ruin falls all the year round, but especially in summer.

Communications.—Both East and West Prussia are traversed by two important lines from Berlin, viz. (1) the Ostbahn, which enters East Prussia at Marienburg, follows the line, Konitz-Dirschchau (junction for Danzig)-Königsberg-Eydtukuhnen on the Lithuanian frontier, where it connects with Vilna and Petrograd. It must cross the 'Corridor', however, and by entering Poland its value as a strategic line is negligible. (2) The line passing through Schneidemühl and Bromberg, in Posen, to Thorn, Allenstein, and Insterburg, where it joins the Ostbahn. There is a continuation to Memel, via Tilsit. The Pillau-Königsberg-Lyck line, with its extension through Poland to Białystok, on the Warsaw-Moskva Railway, and the Danzig-Dirschchau-Marienburg-Deutsch-Eylau line, which permits of communication with Warsaw, are also of importance. A canal connects Königsberg with the Masurian Lakes. Lakes Mauer and Spirding are linked by small canals, and Königsberg is similarly connected with Pillau (q.v.).

Production: Agriculture.—The soil of East Prussia generally is not fertile, and the principal branches of agriculture are fodder-cropping and live-stock breeding, with some cereal and potato raising. Rye and oats are the chief cereals; wheat and barley are not suitable as crops. Peat litter is made in the moor (Johannisburg Heath) district. The province is celebrated for the horses which it used to supply in large numbers for the German army, and at that time the Wehlau (Pregel) horse market was world-renowned. Cattle, sheep, and pigs are also raised. **Forestry.**—About 18 per cent of the surface is afforested, 80 per cent of the trees being coniferous.—**Fisheries.**—These are valuable, smelts, roach, and perch-pike being found in the Haffs in enormous numbers.

Manufactures.—These are of small consequence, and are generally subordinate to and dependent upon local agriculture and forestry. There is some shipbuilding at Elbing and Pillau. Sugar, beer, spirits, and wooden goods are made.

See *Prussia; Germany; Prussia, West; Tilsit;*

Pillau; Königsberg; Vistula; Pregel; European War; and other articles.

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Prussia, West, a former province of Prussia, Germany, the western portion of which was divided between Danzig and Poland by the Treaty of Versailles, and a large part of it now forms what is known as the 'Polish Corridor'. The relics of Posen and West Prussia are now combined as the Border Province; area, 3026 sq. miles; pop (1919), 326,881 (or 108.0 per square mile). Within its confines, West Prussia under the German Empire included the basin of the Vistula, but in its modern form a considerable area of the Polish Corridor and the lands apportioned to the free port of Danzig intervene. East of the Vistula and of the Nogat a small portion remains, and is attached to the detached province of East Prussia (q.v.).

Prussic Acid. See *Hydrocyanic Acid*.

Pruth (pröth), a river of Europe, which rises on the eastern side of the Carpathian Mountains, in the south-east of Galicia; flows circuitously east past Czernowitz, then south-south-east, separating Moldavia from Bessarabia, and enters the Danube on the left, about 12 miles below Galatz. Before the European War it formed the frontier of Roumania for a distance of 379 miles. Its bed is 650 to 1000 feet broad, its depth 13 to 20 feet, and it is navigable for vessels of moderate size to the Husi district and even as far as Jassy. Length, 500 miles.

Prynne, William, born at Swanswick, Somersetshire, in 1600, died in 1669. Educated at Bath Grammar School and Oriel College, Oxford, he took his degree in 1620, and was called to the Bar at Lincoln's Inn in 1628. In 1627 he began with Puritan severity to attack prevailing fashions. For a volume denouncing stage-playing, entitled *Histrionic Mastix*, which was supposed to be levelled at the queen, he was condemned by the Star-chamber to pay a fine of £5000, to stand in the pillory and have both ears cut off, and to remain a prisoner for life. While in prison he wrote another book, *News from Ipswich against Laud*, and being condemned again to another fine of £5000, and to lose the remainder of his ears, had the stumps cut off, and was branded on both cheeks. The Long Parliament in 1640 granted his release. Soon after he entered Parliament and took a prominent part in the trial of Laud. After the fall of Charles I, Prynne opposed Cromwell, who had him again imprisoned. At the Restoration he was appointed Keeper of

the Records at the Tower. He was a most voluminous writer, had much learning and indefatigable industry, but was very deficient in judgment.

Prytane'um, a public hall in ancient Greek states and cities serving as the common home of the community. That of Athens was the most famous. Here the city exercised the duties of hospitality both to its own citizens and strangers. The prytanes or presidents of the Boulé were entertained in it, together with the citizens who were honoured with the privilege of taking their meals at the public cost.

Przemysl (peremishl), a town of Poland, in Galicia, on the San, formerly an Austrian fortress guarding the Carpathian passes across the East Beskids section which give access to the valley of the Vistula and to Lemberg and Cracow. Pop. 55,000. See *Galician Campaign*; *European War*.

Psalmānā'zar, George, the assumed name of a literary impostor, born of Catholic parents in the south of France about 1679, died 1763. He studied among the Dominicans, acted as a private tutor, became a common vagrant, and at length assumed the character of a Japanese convert to Christianity, a character which he changed to that of a converted heathen native of the Island of Formosa. At this time he became acquainted with a clergyman named Innes, who brought him to London as a convert to the Church of England. Under the patronage of Bishop Compton he translated the *Church Catechism* into a language which he invented and called Formosan, while he also published a so-called authentic *History of Formosa*. Various scholars had doubts of his pretensions, and at last he confessed his imposture. For many years after he resided in London, and employed his pen in writing for the booksellers. His *Autobiography*, published after his death, expresses great penitence for his deceptions. Dr. Johnson had a high opinion of his character and abilities.

Psalmody. This term has two widely different applications, according as it is considered in connection with the Roman Catholic or the Protestant Church. In the former case it has reference to the conditions governing the musical recitation of the prose version of the *Psalms* and the manner of employment for that purpose of the Gregorian Tones, and is mainly of interest to the musical specialist. In association with the service of the Protestant Church it has reference to the metrical versions of the *Psalms* and the music to which they are sung, and is of very general interest, since it concerns the active part taken by congregations of the Reformed Church in the praise portion of the services.

VOL. IX.

The history of the origin and evolution of the metrical psalter and of the familiar psalm-tunes is too lengthy to be given here in detail, but those desirous of studying the subject are advised to read the article *Psalter* in Grove's *Dictionary of Music and Musicians* (vol. iii, 1907). The tunes found in the modern psalter come from many sources, but some of the oldest, such as 'Old Hundredth' and 'Old 124th' are found in the *Genevan Psalter*, which dates from 1551. The next important date is 1562, when the first edition of John Day's *Psalter* appeared. This was the first psalter to give a metrical version of all the psalms, and the number of tunes in the book was sixty-five. The influence of the modes is still noticeable in these musical settings, but it is of interest to observe that the great majority of the tunes were in those modes corresponding to our major and minor scales. Other famous psalters were Thomas Este's in 1592, Ravenscroft's in 1621, and John Playford's in 1671.

Psalms. The Hebrew *Psalter* contains 150 odes divided into five books. Psalms ix and x, however, should be one, as in the Greek, and also xlii and xliii. The Greek divides cxvi and cxlvii each into two, and adds a 151 *Psalm* by way of epilogue. The poetic form consists in 'parallelism' arising from antiphonal singing; either the same thought is repeated in two consecutive lines, as ii, 1, or the second line is the converse of the first, as i, 6, or it adds something to it, as ii, 2. These are called 'synonymous', 'contrasted', and 'constructive' parallelism, and two or more of them may be combined. There is no metre and no rhyme. The nearest approach to metre is the '*kinah* strophe', in which each line consists in the Hebrew of five words with a break after the third. The best example of this is xix, 7-9. The only approach to rhyme is a refrain dividing the psalm into stanzas (xlii, xlvi, lxxx, cvii, cxxxvi). In the 'songs of degrees' especially 'anadiplosis' is found (a verse beginning as the last ended, cxxi, 1, 2).

All the *Psalms* except thirty-four have titles. These mention (1) the kind of poem (iii, xvi, xvii, xxx, xxxii, cxlv); (2) musical notes giving the composer or conductor (iv, 1, lxii, lxxiii-lxxxiii, xlii-xlix, lxxxviii, lxxxix), or the accompaniment (v, vi, xlvii), or the air (ix, xxii, lvi, lxxv, lxxxviii, &c.); (3) the liturgical use (xxx, xcii, cxx-cxxxiv); (4) the historical occasion (always from the *Books of Samuel*, as iii, vii, &c.); (5) the authors (seventy-three psalms are ascribed to David). These titles are of the nature of readers' notes. The readers, however, knew what they were doing. Psalm xc, for instance, which is assigned to Moses, bears a strong literary likeness to *Deut.* xxxii and xxxiii.

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Being as old as some of the psalms, these conjectures are of more interest than those of modern European scholars.

As to the age of the *Psalter*, it is now usual to describe it as "the hymn-book of the second temple", the only psalm which professes to be David's being the eighteenth. It is also said that the Hebrew psalms were imitated from the Babylonian, but this simply means that all psalms are more or less alike, and the same might be said of the Vedic hymns. What marks off the Hebrew psalms is that they are monotheistic. That many psalms are post-Exilic (as cxxvi and cxxxvii) is evident enough. Several (as xlv, lxxiv, lxxix) have been well assigned to Macabean times. On the other hand, xlv–xlvi suit best the time of Isaiah. But the bulk of the psalms belong to any or every age.

Our present *Psalter* contains earlier collections. This appears from the note at the end of lxii; from the fact that some psalms occur twice; and that in some books the proper name of God is Jehovah, in others Elohim. There would appear to have been the following editions of the *Psalter*: psalms ascribed to David and using the name Jehovah (book i, psalms i–xli); psalms using Elohim, including psalms of the Sons of Korah (xlii–xlix), of David (li–lxxii), and of Asaph (lxxiii–lxxxiii.) To these lxxxiv–lxxxix would be added later. Books iv and v (psalms xc–cl) use 'Jehovah'. It is clear that book i is oldest, books iv and v latest. Psalms xlii–lxxxiii would seem to date about the time of the *Books of Chronicles* (300 B.C.) in their present form. As to the state of the text, the English reader may judge by examining those psalms of which we have two copies (xviii, liii, lxx, cviii). The alphabetic psalms (ix and x, xxv, xxxiv, xxxvii, cxi, cxii, cxix, cxlv) also help. Many verses are quite unintelligible, the English version being merely a makeshift (as xvi, 3; liii, 5; cf. xiv, 5).

The *Psalms* are essentially religious as Eastern poetry is, but they contain much fine description, and paint human nature on all its sides. (1) Especially religious are those psalms in which the poet depicts the degeneracy of the times in lurid colours (as xiv) and the idol-worship of his neighbours (cxv), whilst never losing confidence in the power of Jehovah to put things right (xciii). This faith even blots out the darker side of life (xxiii, xlv, c, ciii). Often the poet upholds like Job his integrity (vii), and as often he is plunged in despair (the seven 'penitential' psalms). His religion becomes a 'sense of absolute dependence' (lxii, cxxxi). The problem of the *Book of Job* does not touch him; his position is almost that of Job's three friends (xxxvii, xlix, lxxiii). His refuge is in religion, and above all in the temple where he could spend all his

days (lxxiii, 17; xxvii, 4, the 'guest' psalms). The wonder of this faith is that he had no idea of a future life beyond that of a land of shades, Sheol, the Greek Hades (xxxix, 18). Psalms xvi, xvii, xlix, and lxxiii have been interpreted otherwise. In life his employment is meditating upon the law (i, 2; cxix), which does not necessarily mean the Mosaic Law. As a result we have the psalms, mostly alphabetic, which are made up of proverbs (xxv, &c.). The closing psalms are doxologies (cxlviii–cl).

(2) Personal psalms are those in which the poet prays to be delivered from his enemies (v, xvii), or returns thanks for deliverance (ix). The psalmist has no friends; those he had have proved false (xxxv, xli); hence the 'imprecatory' psalms, especially lxix and cix. He fears their triumph over his defeat or misfortune, the Arab *shamátah*, the German *Schadenfreude*. In true Arab fashion he protests his own integrity and honour; unlike the Arab, he abhors both violence and treachery (xxvi). Now he is an outlaw from his tribe (lxix, lxxi); now struggling with physical disease (xxii, xxx, and the gloomiest of all the psalms, lxxxviii) or with mental depression (xlii, xliii). In these, as in all the psalms, however, there is always the question whether the speaker is really an individual or the community of pious Israelites. Wellhausen is inclined to take the former view, perhaps chiefly because Smend and Duhm, who preceded him, took the latter.

(3) Many psalms are patriotic or national in sentiment. Such are those which display loyalty to the king (the 'royal' psalms, xx, xxi, &c.), who may be ideal (cx). Psalm xlv is an epithalamium, but even this may be meant in a mystical sense, as possibly the Song of Songs (cf. Lane, *Modern Egyptians*, p. 412 f.). Other poems are in praise of Jerusalem, both for its beauty of situation and as the dwelling-place of Jehovah (xlvi, xlviii, lxxxiv, lxxxvii, cxxii, cxxxvii). The national history is celebrated in odes which approach epic form (cv, cvi, cxiv, cxxxvi), nor is family life outside the poet's ken (cxxxvii). Many psalms are war-songs: 'salvation' often means victory in war (xx, cxxiv).

(4) Some of the finest of these poems are descriptions of nature. The noblest of these is civ. Psalm cvii also describes first the caravan lost in the desert, then an eastern prison, a raging fever, a ship in distress. A fifth picture is left unfinished. In xxix we have a thunderstorm; in lxviii, 18, a picture of still life; in viii and lxxxi harvest or vintage songs (also lxxv). Psalm xix is the Hebrew version of the German philosopher's "starry heavens overhead and the moral law within".

The Hebrew psalms are the outpouring of the human heart at its best and sometimes at its

worst. They give vent to man's sense of the Divine, his thankfulness for prosperity, his complaint under adversity, his entreaties for protection from his enemies. Now he protests his innocence, and again is plunged in the depth of remorse for his sins. As a rule the psalmist plays on a minor key, but when his optimism does break out it is unclouded. There are few sides of life on which he does not touch, on which a Hebrew or Arab might dwell. And his lines have been the stay of many generations, not only of his own people but even more of the Christian Church, and touch the heart of the pious Muslim perhaps most of all.

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Psalter, specifically, the version of the *Psalms* in the *Book of Common Prayer*; also applied in the Roman Catholic Church to a series of devout sentences, 150 in number, and to a large chaplet or rosary with 150 beads, agreeing with the number of the psalms.

Psaltery, or **Psalterion**, an instrument of music used by the Hebrews, the form of which is not now known. That which is now used is a flat instrument in the form of a trapezium or triangle truncated at the top, strung with thirteen chords of wire, mounted on two bridges at the sides, and struck with a plectrum or crooked stick, thus resembling the dulcimer (q.v.).

Psammetichus (sam-met'i-kus), a king of Egypt who died about 617 B.C. He was one of the twelve kings who reigned simultaneously in Egypt for fifteen years after the expulsion of the Ethiopian dynasty; but being suspected by the other kings of aiming at sole sovereignty, he was driven into banishment. With the aid of some Greek mercenaries, however, he defeated the other kings in a battle fought at Momenphis, on the east side of Lake Marcotis, after which he became the sole king of Egypt (671 or 670 B.C.), and the founder of a new dynasty.

Pseudepigrapha (Gr., false additional writings), a term applied in bibliography to a great number of books and fragmentary writings whose claim to a place in the Old and New Testament canons has been denied. Unlike

the apocryphal and deuterocanonical books, the pseudepigrapha have no value unless to prove the capacity for forgery which was possessed by the Jew, Gnostic, and Christian of ancient and mediæval times. Among these Old Testament forgeries may be mentioned; *The History of Asenath*, *The Preaching of Noah*, *The Book of Elias*, *The Testament of the Twelve Patriarchs*, *The History of Antiochus*, *Book of Lamech*, *Apocalypse of Adam*, &c.; while among the New Testament books are the false gospels of James, Matthias, Thomas, Nicodemus, and Andrew, the *History of Joseph the Carpenter*, *Nativity of Mary*, and the *Acts of Andrew, John, Paul, Peter, and Thomas*.

Pseudomorph, a mineral having a definite form belonging not to the substance of which it consists, but to some other substance which has wholly or partially disappeared. Quartz may thus appear in the form of fluorspar (total replacement of the original material), or limonite in the form of pyrite (partial replacement, iron being common to both minerals).

Pseudonym (Gr. *pseudēs*, false, and *onoma*, a name), a pen-name, a feigned name assumed by an author; also called 'nom de plume', or 'nom de guerre'. Pseudonyms are commonly employed to conceal the identity of a writer, or else merely out of fancy, where there is no idea of concealment. Among famous pseudonyms may be mentioned: 'Boz' (Charles Dickens), 'Lewis Carroll' (C. L. Dodgson), 'Barry Cornwall' (B. W. Procter), 'Eliu' (Charles Lamb), 'George Eliot' (Marian Evans, afterwards Mrs. Cross), 'Thomas Ingoldsby' (Rev. R. H. Barham), 'Junius' (possibly Sir Philip Francis), 'Phiz' (H. K. Browne), 'Ouida' (Louise de la Ramée), 'Mark Twain' (Samuel L. Clemens), 'Artemus Ward' (Charles F. Browne), 'Bab' (W. S. Gilbert), 'Dagonet' (G. R. Sims), 'Anthony Hope' (Sir A. Hope Hawkins), 'Lee Vernon' (Violet Paget), 'Q' (Sir A. Quiller-Couch), and many others.—Cf. Halkett and Laing, *Dictionary of the Anonymous and Pseudonymous Literature of Great Britain*.

Pseudopods, or **Pseudopodia**. See *Protozoa*.

Pseudotsuga, a genus of coniferous trees. *P. Douglasii* is the Douglas fir of the Rocky Mountains, one of the noblest of Conifers. The great flag-staff at Kew Gardens consists of the trunk of one of these giants.

Psilomelane, a common mineral hydrous oxide of manganese, with iron, potassium, and barium, occurring as black mammillated masses in veins. Its crystallized form is Hollandite.

Psilotales, a small tropical and subtropical family of Vascular Cryptogams, comprising the genera *Psilotum* and *Tmesipteris*, sometimes included in Lycopodiales (club-mosses), but better regarded as one of the primary sub-

divisions of the Pteridophytes. They are small, rootless epiphytic plants of simple and probably primitive structure.

Psittacidæ (sit-as'i-dē), the parrot family, comprising over 400 species, of which the genus *Psittacus* is the type. See *Parrot*.

Pskov, or **Pleskov**, a government of Russia; area, 17,069 sq. miles. The whole government belongs to the basin of the Baltic, the Western Dvina, which drains the south-east, carrying its waters into the Gulf of Riga, and the Velikaya, Chelon, and Lovat, with other small tributaries, carrying the rest of the drainage into the Gulf of Finland. The principal crops are rye, oats, barley, potatoes, and flax. The fishing in the numerous lakes of the government is of some value, and forest industries are important.

Pskov, or **Pleskov**, the capital of the Russian government of Pskov, is situated on the Velikaya, and is served by the Petrograd-Warsaw Railway. It consists of the Kremlin, the Central city, the Great city, and a considerable suburb. The cathedral in the Kremlin and that of SS. Peter and Paul are of historical interest. The principal manufacture is Russian leather.

Pso'as, an important muscle of the human body which extends from the lumbar region inside the body cavity to the thigh-bone, and assists in the movements of the thigh.

Psora'lea, a genus of leguminous plants, one species of which (*P. esculenta*) is the bread-root of North America.

Psori'asis is a chronic inflammatory disease of the skin, characterized by well-marked red patches covered with silvery scales. It is a very common skin disease, and though the cause is unknown, a large number of the cases have been shown to be hereditary. There is a marked tendency to recurrences in spring and autumn, and some cases subside and are latent for a time, to break out later. It usually begins in childhood or adolescence, and may persist for many years. Many drugs have been tried, and most success has followed the use of arsenic in the chronic form of the disease. Externally, after the removal of the scales, chrysarobin ointment has been found to be the most effective remedy.

Psyche (si'kē; Gr. *psychē*, the soul), a sort of mythical or allegorical personification of the human soul, a beautiful maiden, whose charming story is given by the Latin writer Apuleius. She was so beautiful as to be taken for Venus herself. This goddess, becoming jealous of her rival charms, ordered Cupid or Love to inspire her with love for some contemptible wretch. But Cupid fell in love with her himself. Many were the trials Psyche underwent, arising partly from her own indiscretion, and partly from the hatred of Venus, with whom, however, a reconciliation was ultimately affected. Psyche by Jupiter's

command became immortal, and was for ever united with her beloved.

Psychiatry. See *Insanity*.

Psychical Research is a term applied to the study of hitherto unexplained and obscure activities of the human mind and of the invisible, unknown world of spirit. Andrew Lang defined psychical research as "the examination of the amount of truth contained in world-wide superstitions". It is thus an interpretation, by aid of psychological principles and theories, of the phenomena investigated. Whilst psychology proper studies the explicable phases of mental phenomena, psychical research is concerned with the mysterious; it covers the borderland set of phenomena that might possibly be resolved into recognized types of events. It is also concerned with supernormal faculties, with forms of mentality transcending those with which everyday humanity is familiar. It is, however, not limited to mental manifestations, for it also investigates undiscovered forms of physical energy. Beliefs in dreams and visions, in apparitions and clairvoyance, and also in the phenomena of hypnotism have existed since time immemorial. For ages humanity believed in spirits and ghosts, in *poltergeister* and tricky spirits, and all unusual phenomena were attributed to their agency. Hydromancy, i.e. clairvoyance by gazing at the surface of still water, and crystal-gazing were practised by the Romans, who were also familiar with the divining-rod for the purpose of discovering water or buried treasure. The belief in premonitions, or warnings received in dreams or by apparitions, has also long been current. The ancients also believed in what we now call telepathy (q.v.). The works of Homer and Euripides, of Virgil, Ovid, and Cicero frequently mention manifestations of the dead, apparitions, evocations, and realizations of premonitory dreams.

Numerous stories which have come down to us from ancient times tend to prove that even savages were conversant with psychic phenomena in the form of superstitions. Again, the story of the witch of Endor, of Saul invoking the spirit of Samuel, is an instance of the belief existing among the Jews in mediumistic phenomena. Christianity, too, was in its origin associated with psychic phenomena. The oracles of Greece, which were the Greek mediums, fraudulent may be, prove the popular belief in psychic phenomena. This belief was opposed by Greek philosophers, but the Neo-Platonists were well versed in the practices of modern spiritualism. Thus Plotinus is supposed to have gone into trances, and Iamblichus gives accounts of psychic phenomena, of phantasms, and materializations. Plutarch relates the story of the assassination of Cesar and the premonitory dream of his wife, Calpurnia—who did her best to prevent

her husband's going to the Senate on the fatal day. And Brutus, who was a philosopher of the Epicurean school, saw an apparition on the eve of the battle of Philippi. References to apparitions and haunted houses are found in the *Letters* of Pliny the Younger.

This belief in agencies working beyond and outside physical nature had a recrudescence towards the middle of last century, when modern spiritualism spread over the civilized world. Sceptics, however, denied the existence of spirit, and declared that all the strange, uncommon, and inexplicable phenomena were the result of fraud and the exploits of clever tricksters. And yet among the believers in supernatural agencies were numerous men and women of intelligence and honesty "who could not all be knaves or fools". The investigation of these obscure phenomena, or alleged phenomena, was bound to attract the attention of scientific men. Whilst admitting that there are gross superstitions, errors, illusions, trickery, and fraud, they had to confess that there are psychic facts worthy of investigation and of scientific explanation; that a world, as ancient as humanity, was open to research and experimental science. These men of science came to the conclusion that it was time to investigate those obscure and mysterious phenomena inexplicable by the known laws of nature. They had no opinions, and approached the subject with unbiased minds, maintaining that here was an open field for inquiry, "as not all faculties and potentialities of man had as yet been explained in terms of nerve and brain".

Thus in 1882 a Society for Psychical Research was founded under the presidency of Professor Sidgwick. In their manifesto the founders of the society declared that their aim was the scientific investigation of the hitherto inexplicable psychic phenomena, and the examination of evidence, both experimentally and statistically, without any bias or preconceived opinions. Among the eminent men of science and the famous philosophers who in the course of time became presidents of the Society for Psychical Research were: Andrew Lang, A. J. Balfour, William James, Boyd Carpenter, Sir W. F. Barrett, Sir Oliver Lodge, Henri Bergson, and Professor W. McDougall (1922). The society stood pre-eminently for investigation rather than belief and conclusions. The majority of the members, however, actually believed in the reality of thought-transference, or telepathy, whilst some of the present members are even convinced of a survival of human consciousness after death, or the existence of disembodied minds. The work of investigation of the so-called residual phenomena was entrusted to six committees, who were to "inquire into the nature and

extent of any influence which may be exerted by one mind upon another, apart from any generally recognized mode of perception; into hypnotism, the so-called mesmeric trance, clairvoyance, and other allied phenomena; to undertake a revision of Reichenbach's researches with reference to discovering whether his 'sensitives' possessed any power of perception beyond a highly exalted sensibility of the recognized sensory organs; to investigate the reports of apparitions at the moment of death, and of houses reputed to be haunted; to inquire into the causes and general laws of the phenomena of spiritualism; and to collect material relative to the history of these subjects".

During the forty years of its existence the Society for Psychical Research has brought to light a great deal of imposture, but it has also established the fact that many of the strange, hitherto inexplicable phenomena really exist. It has been found that healthy persons often experience spontaneous auditory and visual hallucinations and apparently see apparitions or things not forming part of the physical world, such as the apparition of a person at the time of his death at a distance.

Thought-transference experiments have proved that there is frequently a contact between the agent, or person trying to transfer his or her thoughts, and the percipient, or person trying to read these thoughts. Clairvoyance, crystal-gazing, or inducing visual hallucinations at will, have been dealt with and experiments made.

The use of the divining-rod for the purpose of discovering water has been carefully investigated. The results obtained by the rod are supposed to be due to automatic action, subconsciously prompted. Psychical research has also well-nigh established the fact of telepathy, or the occasional communication between living persons without any known intermediary. The prevailing opinion that there was nothing but conscious or unconscious fraud has once for all been proved erroneous.

The great aim of psychical research has been to find out whether some at least of the prophecies, clairvoyant visions, telepathic impulses, or mediumistic messages are true, and whether veritable supernormal communications exist. Once the fact has been established, it becomes the business of science to find out the *why*, *how*, and *wherefore*. Thus the fact of the existence of telepathy has been established beyond doubt, but as for the explanation the tendency is to seek for it in physical causes. It has been explained by brain energy, on the analogy of wireless transmission of electric energy. It is maintained that there are psychic currents, just as there are aerial, magnetic, or electric currents. The vibration produced by one brain is, on cer-

tain occasions, transmitted to another kindred brain by ethereal undulations over long distances.

Another great problem to which psychical research has devoted considerable attention is that of the subconscious activities of the brain, actions being performed by man without leaving any trace on the normal consciousness. Many phenomena, however, with which psychical research deals, can after all be explained by physical laws and noways tend to prove a survival of human consciousness after death. Much more important, therefore, is the phenomenon of spirit messages through trance-mediums. The medium, one of the best-known being Mrs. Piper, passes into a trance, and writes or speaks automatically messages purporting to come from some deceased person. As Mrs. Piper, when in a trance, has shown knowledge far beyond that which she herself possessed, many investigators are inclined to believe that it was really the spirit of a deceased person who used her hand or tongue. Another line of evidence is cross-correspondence.

Cross-correspondence is the theory that several persons receive messages which are singly unintelligible, but have a meaning when combined. Hitherto, it must be admitted, the mediumistic messages have been rather vague and hazy, and the revelations made by the spirits concerning their present existence are somewhat meaningless. As a rule only things which have taken place on this earth have transpired. Nevertheless, many investigators, as for instance Sir Oliver Lodge, are convinced of a post-mortem agency. They have come to the conclusion that the human soul, or human consciousness, continues to exist after death, and that the soul has the power to exercise an influence over another at a considerable distance without the aid of the senses. They maintain that life and consciousness do not become obliterated at the moment of bodily death, and that moreover this persistence after the shock of death is accompanied by individuality and memory. Psychical research thus tends to help religion in corroborating the traditional belief in the survival after death, for once the survival after death is denied, the whole fabric of revealed religion tumbles down like a house of cards.

Psychical research is still in its infancy, but it cannot be denied that it has done valuable work. In spite of this it is still being opposed or derided by scientists and psychologists. It must, however, be borne in mind that hypnotism, mesmerism, and animal magnetism, the exponents of which were called humbugs and frauds, are now recognized by the medical faculties all over the world. When Galvani made his first experiments upon frogs' legs in 1791 he was sneered at, and when Edison's phonograph was exhibited before the

French Academy of Sciences in 1878, an academican maintained that it was the trick of a clever ventriloquist. Whether psychical research will ever be able to prove conclusively that in addition to our physical body we possess another body, composed of etheric substance, that this body survives the shock of death, and that biologists are wrong when they maintain that mind cannot exist apart from matter, is a point still subject to considerable and grave doubt.

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Psychoanalysis. See *Psychotherapy and Psychoanalysis*.

Psychology (Gr. *psyche*, soul, and *logos*, science), or the science dealing with operations of the mind, has been defined as 'the science of the soul', as the science of mind, or as the science of consciousness, and in modern times as the science of 'behaviour' or conduct.

Broadly speaking psychology is the scientific account of our mental processes, investigating our mental experiences. It treats of our powers of attention and sensation, of perception, memory, or the power of retention, of recognition, volition, freedom of the will; of illusions and imaginations, of feelings and emotions, pleasure or pain, taste and smell. It not only inquires into the operations of the mind, with a view to discovering its laws, but also into its connections with and dependence upon other bodily organs, and the action and reaction existing between them. When we think, remember, or endeavour to understand an object presented to the senses, we have an experience, and psychology is the study of the world of experience as distinguished from the study of the world of nature. The problem of psychology is to analyse mental processes into their simplest elements or components. The psychologist analyses these processes, formulates the laws of connection of the mental elements, and explains them in terms of parallel processes in the nervous system. Psychology is thus concerned with thinking, feeling, and acting. It examines the elements of which mind or intelligence is composed, conditions under which mental processes arise, purposes for which they are employed, and the manner in which conduct is controlled.

Method.—The method of psychology is the scientific method, i.e. observation. Whilst, however, the observation of physical science is inspection, the observation of psychology is *introspection*, or looking within. The difficulty

of introspection lies perhaps in the fact that when we are thus analysing our sensations, feelings of comfort and discomfort, of joy and sorrow, we are at once observers and observed. We are actually watching an experience and analysing it whilst we are having it. Another difficulty is the fact that in the method of introspection an experience is dependent upon the experiencing person, and psychology would thus become 'a body of personal beliefs and individual opinions'. The older psychologists, however, maintained that as other men had minds like our own, one is fully justified in basing psychology upon the introspective method and the reports furnished by various observers. Whilst, therefore, the psychologist observes his own mental processes by introspection, he also infers the occurrence of mental processes in others from external signs. We thus study mental phenomena not only in ourselves but also around us, as they manifest themselves externally in others. We study looks, gestures, and actions, and draw inferences from them by considering what we ourselves think or feel when we act in such a way. This method is the external or indirect way of investigating mind. We get at mental facts indirectly by means of certain external manifestations perceived by the senses (experimental psychology). A modern school of psychologists, however, denies the value of introspection. How can we observe, they ask, a mental state whilst it is going on? How can we infer anything about others from our own mental processes?

Behaviourism.—Modern psychologists, therefore, claim for psychology the method of the physical sciences. They advocate the attempt to use external bodily expressions, facial movements, and gestures as manifestations from which one can measure and describe mental activities. In a word, they maintain that just as physiology examines the manner in which human organs act under certain conditions, so psychology must deal with the behaviour and conduct of the individual in certain conditions. The observations must extend to facts which can be seen by any observer. "By Behaviour", writes Pillsbury (*The Foundations of Psychology*), "is meant the activity of man or animal as it can be observed from the outside, or, without attempting to determine the mental states, by inference from acts." Psychology must therefore give up its references to consciousness, and should become a purely objective experimental branch of natural science. It should start from the fact that man and animals are *behaving* beings, adjusting themselves to environment by means of hereditary equipments and habit. Behaviour is modified not only by physical stimuli but also by the results of earlier behaviour. The majority

of psychological problems, human and animal, are therefore grouped in three divisions—sense organ functions, instinctive functions, and habit formations. Professor M'Dougall thus defined psychology as "the positive science of the behaviour of living things". If we succeed in knowing, and completely describing the nervous system of man and the physical laws which govern it, we will always be able to account for the conduct and behaviour of man.

Cognition, Affection, Conation.—In describing our mental processes the older psychologists agreed that there are three varieties of process: cognitive, affective, and conative; that is, a mental experience or process has the three aspects of knowing, feeling, and will. The ultimate constituent is a sensation. It is the simplest experience directly dependent upon the stimulation of a sense organ, or of a sensory nerve. Sensations constitute an acquaintance with a fact without knowing anything about it, and thus awaken no associations or suggestions of past experience. Sensations may be auditory, visual, gustatory, olfactory, cutaneous, or *kinæsthetic*. The last named are sensations *giving the feeling of movement*, or, in other words, keeping us aware of the movements of our limbs; they are due to the fact that we must have a mental picture corresponding to the feeling of the movement we desire to make. Kinæsthetic sensations are due to the stimulation of the receptors terminating in the muscle surfaces.

Intellectual life begins with sensations, but a sensation is not yet a cognition. The latter arises out of a sensation by means of *perception*, i.e. by a process of discriminating one group of impressions from another, and recognizing an object. A perception is thus 'the consciousness of a particular material object present to the senses'. We have, for instance, a sensation of hearing a noise or a sound, but only when we identify the noise as that of a train or a street car are we said to *perceive*, for only then does it convey a meaning to us.

Conative functions deal with voluntary movements and all processes of striving for the purpose of attaining a goal. They cover the movements carried out by means of voluntary muscles, involving the psychical accompaniment of motor sensations. We distinguish impulsive, reflective, and instinctive movements.

Divisions of the Subject.—Not all people possess the same sensations and images. The consciousness of man and his sense-organs may be affected by temporary or permanent derangement, by various forms of insanity, or by the hypnotic state. The operations of the healthy or normal mind are vastly different from those of the diseased or abnormal mind. We therefore distinguish between normal psychology and

abnormal psychology. Psychology again extends not only to man but also to the animal, and just as there is a difference between the mind of one individual and that of another, so there is variation among the minds of individuals and groups. Besides animal or comparative psychology, there is an individual human psychology, and a collective psychology. The latter may be divided into social psychology, ethnic psychology, and class psychology.

History of Psychology.—The study of psychology is older than the name. The term came into use towards the end of the sixteenth century, but was popularized by Wolff in the eighteenth century. The science passed from the philosophical or metaphysical to the empirical stage. Aristotle may be considered as the founder of psychology, although he made no distinction between psychology and biology, which he considered as a part of physics. His treatise *Peri psyches* (*De Anima*), wherein he discusses the faculties of the mental part of man, remained for twenty centuries a textbook of psychology. The Greeks were intensely interested in the nature of the mind, but they treated it in a speculative or metaphysical way. Plato considered human consciousness as a continuation of certain types of existence from earlier ages. Christianity heightened the interest in certain psychological questions, but all through the Middle Ages psychology was more theological than philosophical, not to say scientific.

It was Descartes who gave psychology a new direction by his famous *cogito ergo sum*, and his system encouraged the method of internal observation. The method of analytic introspection was still further developed by John Locke, who treated of innate ideas, and by Bishop Berkeley and Hume. The two Mills, Bain, and Spencer continued the method of introspective analysis. Condillac and La Mettrie in France, Lotze, Herbart, Fechner, and Wundt in Germany are also noteworthy for their contributions to the elaboration and development of psychological problems.

Scientific Psychology.—In contradiction to the philosophical psychology of Fichte, Schelling, and Hegel, scientific psychology, physiological and experimental, arose and was developed in the nineteenth century, 'the century of science'. J. F. Herbart (1776-1831), Hermann Lotze (1817-81), and G. T. Fechner (1801-87) are the most prominent thinkers in the domain of psychology. Under the influence of the evolution theory and the labours of Darwin and Spencer, genetic psychology, child psychology, and race psychology were specially studied. C. Lange and W. James elaborated the theory of 'emotional expression', maintaining that emotions are only strong sensations, or feelings

arising from the movements of the body. The life of feeling is therefore the result of sensationalism. The expressions accompanying emotions, such as sorrow, anger, or fear, "are useful defensive or offensive actions, acquired by man or animal in crises and found serviceable". The habits acquired by man or animal in offence or defence have left after-effects, and are what is felt as an emotion. We thus feel sorry, because we cry; but do not cry, because we feel sorry. Another problem to which psychology in recent years has devoted much attention is the question of unconscious mental phenomena, and the study of double and multiple personality. This study was stimulated by the science of hypnotism. The unity of the mental principle was discussed, and a distinction made between the conscious and the unconscious. Sigmund Freud, who elaborated the system of psychoanalysis, has done much valuable work in this department of psychology. Thus psychology has passed successively from the philosophical to the empirical and from the latter to the physiological stage. For the soul of the theologians, replaced afterwards by the mind, modern psychology has substituted the brain, so that the science has been called a 'psychology without a soul'.

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Psychology, Abnormal. The study of psychology has long engaged the attention of philosophers, but since the beginning of this century it has been the subject of much attention by alienists and other medical specialists. New theories have been advanced, new facts discovered, and new names have been given to old observations; but, now as always, the rules and standards have only a limited application; for neither in body nor mind are we all alike, apart from disease altogether. There is wide divergence in the faculties of men and in the way they act, and when they live orderly lives and contribute their fair share to the world's work, if they fail to reach the standard of normal psychology the fault may be as much in it as in them. The standard of normality is purely arbitrary, and it is doubtful if anyone, even among those who formulate it, attains to it wholly and at all times; but in so far as it is a working measure for purposes of comparison, it is useful. Though we do not all think and act alike and do not respond to the same stimuli in the same manner or degree, there are the exceptions who behave so differently

from their neighbours as to earn the reputation of consistent eccentricity. In the eyes of the law we are all held to be sound enough mentally to be accountable for our acts, in the absence of evidence to the contrary; and the assumption is a reasonable one though it is not always justified by the facts. The psychologist cannot admit it, for he is as little entitled to assume that all men are sane as that they are not. He has his standards by which he may judge them, but he does not always carry conviction when he applies them, his personal and professional bias being factors in the case as well as the mental condition of the patient. His work has, however, resulted in breaking down the hard and fast rules of the lawyer, since it has demonstrated the fact that they have tended to exclude from consideration facts that were important, or have at least underestimated their importance. As a community we have made provision for those whose mental condition is such that they are unable to take care of themselves or are a source of danger to others. If they are certified to be insane or are suffering from a mental defect which has existed from birth or from an early age, they may be placed under supervision either in institutions or with approved guardians outside; but there are persons who differ mentally from their neighbours to a notable extent, who are neither insane nor mentally defective within the meaning of the Acts, and whose conduct may so annoy their neighbours as to call for action being taken regarding it. Some have argued that all crime and wrong-doing is due to the abnormal psychology of the offender. In a sense the saying that 'to know all is to pardon all' reflects this view, but if it is correct, it would follow that the thief cannot help stealing and is not responsible for his wrong-doing; and experience shows that this generally is not the case. Motives that seem sufficient to one man, to lead him to do certain things, may be without apparent influence on another; and psychologists attempt to show why this is so by inquiring into the state of mind of the person who departs from the ordinary lines of conduct.

The case of the criminal has received more attention than that of others because, as a result of his actions, he has been placed in a more prominent position than many who are more eccentric, and there has been more opportunity to study him; but, in so far as the study takes place while he is in prison, he is seen under abnormal conditions, and is as little like his free self as a bird in a cage is like one in its natural surroundings.

That some prisoners have abnormal psychology nobody will deny, but that in this respect they differ from many who have never transgressed the law is not so clear. Even if it were proved

that wrong-doing is due to abnormal psychology, we would still have to combat it. It is nothing new to hold that the only way to turn the evil-doer from his course is to change his disposition. Our fathers called it a change of heart and we may call it a change of mind. The psychologists may help the penologists by prescribing for the offender, but it will be a doubtful benefit if he is merely placed and kept in a prison with another name. Other classes of men have received a great deal of attention as having abnormal psychology. Men of genius and men in high positions have each furnished texts. The criminal is like the king of old in so far as the law bound neither, and whatever their psychology might be to begin with, it was bound soon to differ from that of their contemporaries. The man of genius, because of his faculty, does not meet with other men on equal terms, and he also is an example of abnormal psychology. Attempts have been made to prove that genius is allied to insanity, but they have only shown that men of genius, like men without it, have suffered from ailments and diseases that afflict both sane and insane. Much of the progress of the race has been due to men who were abnormal psychologically, according to the standards of their time. They have revolted against conditions as they found them, and have led others. Those whose sanity has been least questioned have not always been the greatest blessings to mankind, and those who have been so eccentric in their behaviour as to be looked on as mad have in some cases proved wiser than their normal-minded neighbours. Abnormal psychology is a term that covers all mental conditions that do not conform to the ordinary standard, except insanity and mental defect. It may refer to cases where there is no tendency to wrong-doing and no sign of any mental disorder, and it may be as applicable to cases where there are anti-social tendencies or mental disturbance tending to insanity.—BIBLIOGRAPHY: Freud, *Psycho-Pathology of Everyday Life*; J. B. Watson, *Psychology from the Standpoint of a Behaviourist*; J. H. Coriat, *Abnormal Psychology*; H. Goddard, *Psychology of Normal and Sub-normal*.

Psychotherapy and Psychoanalysis. *Psychotherapy* is that branch of medical treatment which is concerned with the means of alleviating disorders of psychological (or mental) origin. *Psychoanalysis* is only one of the methods of psychotherapy, certainly an important one, but at the same time a method which at the present time is causing a degree of concern, to lay public and medical profession alike, out of all proportion to its significance or usefulness in the therapeutics of nervous diseases.

Nervous and mental diseases have usually been classified broadly into two groups, viz.

organic and functional. *Organic diseases* are those in which there is definite structural damage to nerve tissue, e.g. through cutting off of blood supply or through degenerative processes affecting the neurons.

Functional diseases are those in which symptoms manifest themselves, but which rest upon no certain basis of observed microscopic or naked-eye change in nerve tissues (as far as present knowledge goes). Some of these functional disorders are certainly purely psychological in origin. It has to be remembered that every condition of ill-health is the product of a variety of influences and factors which have combined to bring about the disease picture presented by the patient, and that both physical and mental factors are at work in every case, though to varying degree and with varying relative importance in different instances. In cancer of the stomach, for example, certain symptoms may be seen which to some extent are mental in origin, but these are insignificant compared with the symptoms due to the actual organic change in the stomach. On the other hand, in a complete paralysis of the lower limbs in hysteria the dominating causative factors are mental (and readily curable), although physical agencies may have played a certain part. It is obvious that in diseases due to demonstrable physical or chemical changes, treatment must be different from that in diseases dependent chiefly on disordered psychology. Psychotherapy is mainly employed in the latter, although it may also play a minor part in the treatment of mental symptoms appearing in the course of an organic malady.

Functional nervous diseases are often referred to generally as *neuroses*. They include hysteria, neurasthenia, psychasthenia, anxiety neuroses, &c., and the majority of the disturbances which were grouped under the term shell-shock during the European War. Some neuroses are of entirely psychological origin, others are not so, and the former are usually referred to as psychoneuroses. It is for these especially that psychotherapy is the rational treatment, and it is amongst them that it finds its widest scope. It is also largely employed in the treatment of actual insanities, but it is not yet quite determined to what extent it is curative in this domain. We are not at present able to say in the case of many of the insanities whether the disturbance is purely of psychical origin, or whether it mainly results from disordered or poisoned bodily function; hence the difficulty in settling the place of psychotherapeutic measures in the treatment. But it certainly can be said that in dealing with actual insanities psychotherapy may prove a valuable accessory in many cases, and may possibly be helpful as

a preventive measure in early and borderland cases of mental disorder. Psychotherapy is widely employed as an adjunct to treatment in ordinary medical practice, and here it finds perhaps its most important and universal application. As already pointed out, every condition of ill-health presents symptoms of psychical origin, and the mental factors exert a definite though perhaps not vital influence on the outcome of the illness, as everyone no doubt will admit. Every practitioner of medicine realizes that therapeutics is not the treatment of disease but the treatment of the patient, and he knows that mental as well as physical agencies have to be employed in each individual case. The practising doctor is thus employing psychotherapy every day in the course of his ordinary avocation, occasionally perhaps unconsciously, frequently purposely. It may be done simply through his ability to inspire the patient with cheerfulness and hope, or he may designedly employ powerful suggestion, knowing his patient and being certain of its due and beneficial effect. Countless complaints that come before the doctor are dissipated, entirely or almost entirely, during the consultation, simply because he has been able to assess the insignificance of the symptoms and to convince the anxious inquirer that there is no real ground for fear. Psychotherapy therefore is no new thing. But although its use is universal in the healing art and in the hands of every practising physician, it requires for its special application (i.e. to some of the neuroses and insanities) much time and special training and experience. Unfortunately it is extensively practised as a speciality at present by many outside the medical profession who have no real claim to be its exponents. The obvious risk arising from this is that psychotherapy may be employed, whilst clamant need for physical treatment is overlooked; or that, given a purely psychological disorder, psychotherapy may be used along wrong lines. For its correct practice requires long experience and careful observation of suffering humanity both in the domain of general medicine and in nervous and mental disorders.

In its intensive application psychotherapy has greatly extended during recent years. During the European War the number of cases of neuroses was greatly increased both in civil and military populations. Neuroses in war, however, arise just as in peace from combinations of mental and physical shocks or strains; there is no exclusive 'war-neurosis', he it noted. In other words, there is no war-neurosis which does not have its counterpart in civil life, although in peace-time the conditions and circumstances appearing as proximate causes may be for the most part different from those in war. But

the fact of the increase of such illnesses, in the war years and since, remains, and thus the special application of psychotherapy has come more prominently before the public and the medical profession in general than in former times. Specialists in psychotherapeutics would seem to differ greatly in their views as to the ways in which psychotherapy may be employed to best advantage. These questions have been extensively discussed and written about in recent years, and it would sometimes appear that every authority advocated some one method to the exclusion of all others. Differences in this regard are probably more apparent than real, however, and each different method no doubt has its proper sphere in treatment. There are four main processes employed, namely, *persuasion*, *suggestion*, *analysis*, and *re-education*. The process best suited differs in different cases, and for each patient requiring intensive psychotherapeutics the method of application has to be selected after careful consideration of the case in all its aspects, and after a correct diagnosis has been arrived at both as regards physical and mental condition. It is common to confuse psychoanalysis with psychotherapy, and to think that the latter and suggestion or auto-suggestion, &c., are synonymous terms; whereas psychoanalysis is only one of the methods of psychotherapy and suggestion another one; both have their place, but neither is by any means universally applicable.

Persuasion.—This is a form of treatment which appeals to the reason and the will and enforces its claims on logical grounds. Persuasion is employed every day by every physician in dealing with his patients. As systematically applied in psychotherapy it means a thorough physical examination of the patient, so as to ensure that none of his symptoms are dependent on organic diseases but arise simply from functional disturbances of psychic origin. The origin and causes of the complaint are discussed with and explained to the patient fully. He is reassured as to its curability. The physician then proceeds to demonstrate how the lost and perverted functions may be recovered and rectified, and directs the patient as to the measures which are further necessary for the complete cure of the complaints.

Suggestion.—Here the patient is made to accept a proposition in the absence of logical grounds. Ideas are introduced into his mind without encountering the critical judgment of the reason. In certain neuroses symptoms are due to mental factors of which the patient is unaware, but by means of suggestion the mere conviction implanted in the mind may modify the responsible mental factors and thus cause disappearance of the symptom. There are two

main methods of suggestion—waking suggestion and hypnotic suggestion. In *waking suggestion* the conviction is simply authoritatively conveyed by word of mouth, or certain physical means may be employed with the deliberate intention of producing a suggestive effect. In *hypnotic suggestion* the patient's mind is put into a quiescent state, and his power of criticism is more or less in abeyance. Repeated use of this may in some instances be harmful, but there are cases where hypnotic suggestion is needed when other methods fail. It is certainly the most powerful means of applying suggestion, for in the hypnotic condition a patient is much more 'suggestible' than in the waking state.

Analysis.—This is a method which may be termed mental exploration, and which is directed to the investigation of the precise mental causes of a psychoneurosis with a view to their removal. The term 'psychoanalysis' is often used as synonymous with 'analysis', but strictly speaking psychoanalysis is a special kind of analysis, its methods being based on certain theoretical views held by certain authorities as to the causation of psychoneuroses. Analysis has been likened to, and in point of fact really amounts to, the old method of the confessional where "the sinner poured out his soul into the sympathetic ear of the priest". The factors underlying a disorder are frequently not present on the surface of the mind, so to speak, but are hid in its depths, and the analyst essays to bring them to the light. It can readily be understood that this is a difficult procedure, and a time-consuming one, exhausting alike to the patient and to the doctor. It should not be attempted by all (even by all doctors), but it is *the* method of psychotherapy which unfortunately has been seized on by quacks of various kinds for purposes of money getting, a regrettable circumstance which tends to bring a valuable method of treatment into undeserved disrepute. In connection with analysis it is necessary to have some understanding as to modern psychological teaching regarding the mental processes. According to this our thoughts are guided in two ways which distinctly differ. The first way is by means of intelligent argument, whereby each element of thought is logically inferred from that immediately previous; much in the same way, it might be said, as the different statements of a mathematical proposition are developed. The other process guiding thought depends upon and is directed by the power of 'complexes'. Complexes are repressed ideas with strong emotional tone which reside deep in the unconscious mind. Emotional tones can tinge all the mental processes of the individual so that he may regard things not in a cool, reasoning, and logical way

but through a perspective largely influenced by emotion. Thus it is that an individual may for example take an instinctive dislike to another at first sight, and thus are explained, to some extent at all events, the countless things that an individual may or may not do, not on any logical ground but purely intuitively. Complexes may be said to consist of different constituents or 'instincts' which are present in different proportions in different complexes, e.g. the instincts of self-preservation and self-assertion, the herd-instinct (common to all creatures and also man), the sex instinct, &c. Consciousness is now regarded as consisting of three different layers. There is first of all the active consciousness which is concerned with the thoughts of the moment. Then there is what is termed the liminal consciousness containing thoughts not uppermost in the mind, but which can be called up by a slight effort of memory. Then there is again a deeper stratum of the subconsciousness termed the sub-liminal consciousness, and here reside thoughts which do not rise into active consciousness at all and can only be brought into it by some special way and that often with difficulty. Thoughts in this level of the subconscious are usually painful ones, and they are kept there by an active process of forgetting which is termed 'repression'. Repression may, however, at times be in abeyance, and a painful impression may force itself, as it were, to the surface. An example of this occurs in dreams. From childhood onwards a nucleus of complexes forms in the subliminal consciousness, and it consists of the sum total of primary impulses or instincts which have been repressed as a result of education and environment. These complexes may in certain people interfere one with another, and so an individual may be swayed in one direction or other accordingly as one or other complex has the stronger 'pull', so to speak. In this way there arise in the subconscious mind what are termed 'conflicts'. For example, a soldier who is in the front line, impelled by the emotion of fear, may wish to escape. This complex, however, is in conflict with that of the 'social ideal' (involving the 'herd-instinct' of discipline, pride of race, &c.), which impels him to stick to it. Normally the herd-instinct should be dominant, but it may not be. There is thus in any case a conflict, which may be solved in one way or another. If not, the two impelling complexes may be equally balanced, and neither of them may be powerful enough to solve this conflict between self and duty, and so a mental dilemma arises. If he is unable to solve this he may develop a neurosis which persists until his conflict is dissipated. As long as it is undecided or unrealized he suffers from this psychoneurosis; the conflict may be entirely subconscious or it

may be an active struggle in the conscious mind. Conflicts are many and various, and the above is only a single instance. It is in cases where the neuroses depend on conflicts, especially subconscious ones, that analysis finds its greatest usefulness, and in such cases it may be said to be absolutely essential. It often is combined with 'suggestion' and 'persuasion', and also with physical treatment, and it may be carried out either in the waking or the hypnotic state, though the latter is seldom necessary. It deals with the unconscious tendencies which lie at the root of many neurotic symptoms. It comprehends an investigation of the patient's past emotional history, and a study of his dreams while asleep; in this way gaining clues as to subconscious conflicts in the way of fears, anxieties, and unfulfilled desires. It inquires what an individual tends to think of when his thoughts wander off during the day (day dreams). Its methods are various and are applied differently in different hands, but by its use we may discover that some special anxieties or troubles tend to crop up which the patient constantly tries to repress, and we may thus unearth some conflict which may form the basis of a whole train of neurotic symptoms.

Re-education.—This is the process of training a disordered function to return to its normal method of activity. It cannot be said to be strictly homologous with the other methods of psychotherapy already described, but is to be looked on more as an adjunct and as a sequence to their employment. It completes the process of cure. It runs along two lines, one of which comprises the re-educative exercises necessary to train, e.g. an unsteady and previously paralysed limb into normal and precise movement. The other line involves re-education, moral, social, occupational, &c., directed to training the neurotic to resume an efficient existence.—BIBLIOGRAPHY: G. F. Stout, *Manual of Psychology*; Susan S. Brierley, *Introduction to Psychology*; James Harvey Robinson, *The Mind in the Making*; Ernest Jones, *Psychoanalysis*; S. Freud, *Psychopathology of Everyday Life* (translated by A. A. Brill); *On Dreams*.

Ptarmigan (târ'-), a game-bird of the pheasant family (Phasianidæ), distinguished from the true grouse (q.v.) by having the toes as well as the tarsi feathered. The common ptarmigan (called also *white grouse*) is the *Lagopus mutus*. The male is about 15 inches long, the female about an inch less. In summer the predominant colours of its plumage are speckled black, brown, or grey, but in winter the male becomes nearly pure white, and the female entirely so. In Britain it is to be met with only on the summits of some of the highest Scottish hills, chiefly amid the Grampians, in the Hebrides and Orkneys, and sometimes but

rarely in the lofty hills of Cumberland and Wales. The willow-ptarmigan or willow-grouse (*L. albus*) occurs in great abundance in the arctic regions of America and in Norway, whence great numbers are brought to the London market.

Pterichthys (te-rik'this), a fossil genus of fishes occurring in the Old Red Sandstone. The head and fore-part of the body were protected by a buckler of large ganoid plates fitting closely to each other. The caudal portion was free, and seems to have been covered with small, round enamelled scales. *Pterichthys* was peculiarly characterized by the form of its two pectoral fins, which were long and narrow, something like wings (whence the name—'wing-fish'), covered by finely tuberculated bony plates. Their spine-like form suggests that they were used for defence as well as progression.

Pteridophyta, or **Vascular Cryptogams**, one of the primary subdivisions of the Higher Plants or Cormophytes, including ferns proper (Filicales), club-mosses (Lycopodiales), horse-tails (Equisetales), and the less familiar Psilotales and Sphenophyllales, the last-named group comprising only extinct forms. They are higher in the scale than Bryophytes, the dominant generation being a sporophyte (q.v.) with well-developed vascular tissue. Although heterospory occurs in some cases, genuine seeds are never formed. The living plants are mostly herbaceous, and even when large show no appreciable secondary thickening (q.v.), although many of the extinct types were in these respects little inferior to woody seed-plants.

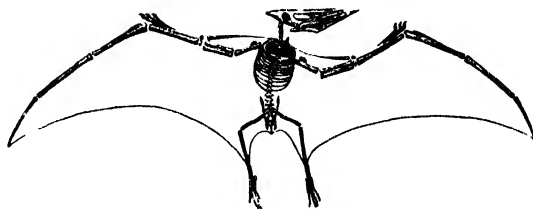
Pteridosperms, an important group of fossil plants, mostly of Carboniferous age, formerly regarded as ferns, but now known to have been reproduced by true seeds and to be linked with higher groups.

Pterocarpus, a genus of leguminous plants, species of which yield kino, dragon's-blood, red sandal-wood, &c.

Pteroceras (ter-o'se-ras), a genus of molluscs inhabiting the Indian Ocean; the scorpion-shells. The head of the animal is furnished with a proboscis and two short tentacles. The shell is oblong, the spire short, the mouth produced into claw-like spines, and the operculum horny. *P. scorpio* is known by the name of the *devil's-claw*. At the least ten recent and twenty-seven fossil species of this genus are known.

Pterodactylus ('winged-finger'), a genus of extinct flying reptiles of the ord. Pterosauria (q.v.), found in Jurassic strata, for instance in the Kimmeridge clay and Stonesfield slate of England, and especially in the Upper Jurassic lithographic stone of Bavaria and Württemberg.

The pterodactyls had a moderately long neck and a large head; the jaws were armed with equal and pointed teeth. A number of species have been discovered, most of them small or of moderate size, but one must have had an expanse



Restoration of Skeleton of Pterodactyl

of wing comparable with that of a large eagle. The great Cretaceous 'pterodactyls' are now referred to Ornithocheirus.

Pterop'ida, a family of Chiroptera, called fox-bats from their long and pointed fox-like head. The type-genus is *Pteropus*.

Pterop'oda, or **Sea Butterflies**, a group of sea-snails, comprehending those which have a wing-shaped fin on each side of the head and neck, being thus a sort of 'winged snails'. Some are shell-less, while others possess elegant transparent shells composed of calcium carbonate. They are all of small size, are found floating on the surface of the ocean in all parts of the world, and in the Arctic and Antarctic regions furnish much of the food of the whale.

Pterosaur'ia, an extinct order of flying reptiles of Jurassic and Cretaceous age, represented chiefly by the Pterodactyls (q.v.). Some pterosaurs possessed long tails ending in an expansion that served as a rudder. The bones are set with hollows, as in the birds. The jaws in most genera contain teeth in sockets. The membranous wings were supported by the elongation of one finger only; three other fingers occur, bearing claws. The hind-foot has four or five toes with claws. Ornithocheirus had a wingspan of about 20 feet.

Pterostylis, a genus of Australasian orchids, with a very curious pollination mechanism. The labellum is irritable, and the rest of the perianth forms a hood at the back of the flower. When an insect lands on the lip, it springs up and imprisons the visitor, which can escape only by squeezing past the stigma and anther. After about half an hour the lip bends down again, and is ready for the next visitor.—Cf. Darwin, *Fertilization of Orchids*.

Pterygo'tus, a fossil crustacean attaining a length of 6 feet, occurring chiefly in the passage-beds between the Silurian and Devonian systems. It has a long scorpion-like form, composed in the main of a cephalo-thorax, an abdominal

portion of several segments, and a somewhat oval telson or tail-plate. See *Merostomata*.

Pthah, or **Phtha**, an ancient Egyptian divinity, the creator of all things and source of life, and as such father and sovereign of the gods. He was worshipped chiefly at Memphis under the figure of a mummy-shaped male, and also as a pygmy god.

Ptolemaic System, in astronomy, that maintained by Claudius Ptolemy, the astronomer, who supposed the earth to be fixed in the centre of the universe, and that the sun, planets, and stars revolved around it. This long-received theory was rejected for the Copernican system. See *Astronomy*.

Ptolemy (*Ptolemaios*), the name of a line of Græco-Egyptian kings, who succeeded, on the division of the empire of Alexander the Great, to the portion of his dominions of which Egypt was the head. They were also distinguished by the surname *Lagida*, from Ptolemæus Lagus, the founder of the dynasty.

Ptolemy I (born in 367 B.C., died in 283), called *Soter*, the Saviour, was by birth a Macedonian. His mother was Arsinoë, the mistress of Philip, and his father is commonly reputed to have been Lagus, a Macedonian of humble birth. Ptolemy was one of the intimate friends of Alexander, attended the king on his expedition to Asia, was admitted into the bodyguard, and in 329 B.C. commanded one of the chief divisions of the army. On the death of Alexander he attached himself to the party of Perdiccas, and secured for himself the government of Egypt. He married Eurydice, daughter of Antipater, and in 320 B.C. he seized the satrapy of Phœnicia and Cœle-Syria. In 308 he invaded Greece, and proclaimed himself as a liberator; but he made little progress, and having garrisoned Corinth and Sicyon, which he lost some years later, he returned to Egypt. Antigonus resolved to wrest Cyprus from Ptolemy (307 B.C.), and in a sea-fight at Salamis the Egyptians were defeated, and Cyprus fell into the hands of the victor, who assumed the title of king. Antigonus now advanced against Egypt through Syria with a powerful army, supported by a fleet; but he was ultimately compelled to retire, while a few years later Cyprus was recovered and became a permanent dependency of Egypt. He was a great patron of art, learning, and literature, and founded the celebrated Alexandrian Library.

Ptolemy II (*Philadelphus*), born 309 B.C., died in 246. He succeeded his father, and reigned in almost complete peace. His chief care as ruler was directed to the internal administration of his kingdom. He spared no pains to fill the library of Alexandria with all the treasures of ancient literature, and among the architectural works erected during this reign were the lighthouse

on the Island of Pharos, the Alexandrian Museum, and the royal burying-place. He founded numerous cities and colonies, and during his reign the dominion of Egypt extended into Ethiopia, Arabia, and Libya, and embraced the provinces of Phœnicia and Cœle-Syria, besides tracts in Asia Minor and some of the islands of the Mediterranean.

Ptolemy III (surnamed *Euergetes*, 'benefactor'), born 281 B.C., died in 221. He was early engaged in an important war against Syria, after invading which he advanced without opposition to Antioch, then turned eastward, subduing Mesopotamia, Babylonia, &c. The fleets of Ptolemy had at the same time subdued the coasts of Asia Minor, and carried his arms to the Hellespont and to the coast of Thrace. Ptolemy took some part in the affairs of Greece against the rulers of Macedonia, and maintained friendly relations with Rome. Like his predecessors, he was the patron of scholars, and his court was the resort of the most distinguished men of his day.

Ptolemy IV (surnamed *Philopator*), succeeded in 221 B.C., died in 204. His Syrian possessions having been gradually wrested from him by Antiochus the Great, Ptolemy put himself at the head of a large army and completely defeated Antiochus at Raphia in 217 B.C. He subsequently gave himself up completely to debauchery.

Ptolemy V (surnamed *Epiphānes*), son and successor of Ptolemy IV, born in 209 B.C., died in 181. He was under five years old at his father's death, and this led Philip of Macedon and Antiochus III (the Great) of Syria to combine to dispossess Ptolemy, and divide his dominions. To avert this danger the guardians of the young king placed him under the protection of Rome, which thus had first an occasion for interfering in the affairs of Egypt.

Ptolemy VI (surnamed *Philomētor*), born in 186 B.C., died in 145. His reign was much disturbed by the rivalry of a brother, and being expelled from Alexandria, he repaired to Rome (164 B.C.), by whose intervention he was replaced. During the reigns of the succeeding Ptolemies the influence of the Romans in Egypt gradually increased, with a corresponding decrease in the independence of the native sovereigns. The personal character of the Ptolemies also degenerated, a fact to be probably connected with the common practice in the family for brothers to marry sisters.

Ptolemy XI (*Aulētēs*, 'flute-player') was driven from his kingdom by his subjects, who were ground down by taxation; but he was restored by the Romans (to whom he gave great sums of money), and died in 51 B.C.

Ptolemy XII (*Aulētēs*), son of the preceding,

reigned jointly with his sister Cleopatra till 48 B.C., when Cleopatra was expelled, and raising an army in Syria, invaded Egypt. On the arrival of Cæsar, Cleopatra by her charms acquired an ascendancy over him. Ptolemy put himself at the head of the insurgents, was defeated by Cæsar, and drowned in attempting to make his escape (48 or 47 B.C.).

Ptolemy XIII (*Aulētēs*), the youngest son of Ptolemy XI, was declared king by Cæsar in conjunction with his sister Cleopatra in 47 B.C. He was married to his sister, but, being only a boy, possessed no more than the name of husband or king. Cleopatra caused him to be put to death, and the line of the Ptolemies ended when Cleopatra perished by her own hands after Octavius defeated Antony at Actium, and Egypt became a Roman province (30 B.C.).

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Ptolemy, Claudius Ptolemæus, Greek astronomer and geographer of the second century after Christ. He appears to have resided in Alexandria, where he made astronomical observations in 139, and he was alive in 161. Ptolemy's great astronomical work is entitled *Megalē Syntaxis tēs Astronomias*, and is more commonly known by the Arabic title *Almagest*. Equally important is his *Geography*, in eight books, largely based upon the lost works of Marinus of Tyre, and for centuries an authoritative treatise. See *Ptolemaic System; Astronomy*.

Ptomaines (tō'ma-ins), alkaloid-like substances, most of them poisonous, found in decaying animal matter. Some examples are cadaverine, putrescine, choline, and neurine. *Cadaverine*, $\text{NH}_2(\text{CH}_2)_5\text{NH}_2$, is a colourless syrupy liquid of pronounced spermaceti odour, which, on giving up ammonia, yields *piperidine*. Many ptomaines occur in the vegetable kingdom. *Muscarine*, $\text{C}_6\text{H}_{15}\text{NO}_3$, an excessively poisonous base, is present in toadstool (*Agaricus muscarius*). Ptomaines may occur in preserved food-stuffs, and cause *ptomaine poisoning* (see *Toxicology*).

Ptosis, a drooping of the eyelid owing to paralysis of the muscle that lifts it. It is sometimes congenital, and it may be produced by various disorders of the brain.

Ptyalism, or **Salivation**, is excessive secretion of saliva, and is often the result of excessive doses of certain drugs, more especially mercury, the iodides, and pilocarpine. It is also seen in chronic disease of the pancreas, and may occur with the morning sickness of pregnancy. The treatment consists in the removal of the cause, when possible, and the administration of belladonna, accompanied by the use of astringent mouth-washes.

Pu'berly, the period in both male and female

marked by the functional development of the generative system. In males it usually takes place between the ages of thirteen and sixteen; in females somewhat earlier; and, as a rule, in very warm climates puberty is reached somewhat sooner than elsewhere. In males puberty is marked externally by the deepening of the voice, the first appearance of the beard, greater firmness, fullness of body, &c.; in females, by the enlargement of the breasts and by the general rounding out of the frame, and most unequivocally of all by the commencement of menstruation.

Publicans, or **Publicani** (from *publicus*, belonging to the State), the farmers of the taxes levied in the territories of ancient Rome. The revenues derived from the tribute of foreign countries were sold or let for a period by the censors in Rome to the highest bidder. The sale was generally made for a *lustrum* or period of five years. The conditions of the sale were as a rule determined by law, but were sometimes modified on particular occasions. The farmers of the revenue belonged to the wealthier classes, and were from their functions unpopular. Far more unpopular were the subordinates whom they employed to collect the taxes for them. In Palestine, from the strong spirit of nationality among the Jews, many of whom denied the lawfulness of paying tribute, these were specially obnoxious as the agents of the foreign rulers. To this detested class, and not to the *publicani* proper, the 'publicans' of the New Testament belonged generally.

Public Authorities Protection Act, a statute passed in 1893, limiting to six months the time within which legal proceedings may be instituted by a private party against any person or authority in respect of an official act, neglect, or default in the execution of an Act of Parliament or public duty or authority.

Public Health Acts, certain British Acts of Parliament regulating sanitary matters. The sanitary administration of England (with the exception of London) is mainly regulated by the provisions of the Public Health Acts of 1875 and subsequent years. The superintending and controlling authority was formerly the Local Government Board, but is now the Ministry of Health established in 1919. The local sanitary authorities are the county councils, district councils, &c. The local authority, however constituted, is armed with very extensive powers. To aid in the exercise of these it must appoint a medical officer, an inspector of nuisances, and in urban districts a surveyor. As regards the health of a district, the local authority can ensure a due supply of water, make and maintain sewers and utilize sewage, provide for the cleansing of streets, remove nuisances of

every kind, including those which arise from offensive trades, prevent overcrowding in common lodging and other houses, and enforce a supply of proper privy accommodation. It can close dwellings unfit for human habitation, and if the owner neglects to put them in a proper state, can do so at his expense. It can compel the cleansing of houses in which there is infectious disease, and establish temporary hospitals for sufferers from it. For these and many other purposes connected with the health of the community it can levy rates and raise loans. The Public Health (London) Act was passed in 1891. The Act of 1875 has been supplemented by others dealing with water-supply, the removal of nuisances, the pollution of rivers, vapours from alkali works, public burial-grounds, compulsory vaccination, the adulteration of food and drugs, with the appointment of public analysts, and the notification of infectious diseases. For special classes of the community there are the laws relating to factories and workshops; the measures regulating labour in mines, bakehouses, &c.; the Children Acts, 1908 to 1921; and measures, known as the Housing Acts, 1890 to 1920, dealing with the housing of the working-classes. For Scotland the chief sanitary enactment is the Public Health (Scotland) Act of 1897. The supreme controlling authority is now the Scottish Board of Health, the successor of the Local Government Board for Scotland; and the local sanitary authorities are town and county councils, district committees, and burgh commissioners. For Ireland the chief sanitary enactment was the Public Health (Ireland) Act of 1878, framed on the lines of the English Act of 1875. Under that Act the controlling authority was the Irish Local Government Board, with local sanitary authorities, urban and rural, under it.

Public Prosecutor, an official charged with the prosecution of all criminal offences. In England, unless in a few exceptional cases, any private person may institute a criminal prosecution. A salaried director of public prosecutions, with very limited powers, was appointed in 1879, but in 1884 his title and his functions were transferred to the Solicitor to the Treasury, who now prosecutes on behalf of the State in criminal cases of importance or difficulty, or when special circumstances appear to him to justify the step, and who may intervene in any criminal proceedings instituted by the local police or by a private prosecutor. In Scotland there are practically no private prosecutions for criminal offences. The Lord-Advocate is *ex officio* public prosecutor, and the whole expense of public prosecution is borne by the public, criminal prosecutions being initiated by the procurators-fiscal, who are officials specially

appointed for this purpose. (See *Procurator-fiscal*.) In Ireland a system of Crown solicitors and Crown agents has very largely superseded prosecutions by private persons.

Public School, a grammar-school founded or endowed for the use or benefit of the public, and carried on under some kind of public management or control; contrasted with a 'private school', which is carried on at the risk and for the profit of its master or proprietors. Eton, founded (1440) by Henry VI, is the most famous among English schools. Keate was a celebrated headmaster; while distinguished pupils include Canning and Chatham, Fox and Fielding, Porson and Pusey, Kinglake and Shelley. Harrow, the chief rival of Eton, was founded (1571) by a farmer. It is famous for the excellence of its music; for its century-old annual cricket match against Eton; and for having educated, amongst others, Byron, Cardinal Manning, and Lord Palmerston. Rugby, founded (1567) by a grocer, is indissolubly connected with its great 'head', Dr. Arnold, and further gives its name to one of the two principal varieties of football. Shrewsbury, a foundation (1551) of Edward VI, is fortunate in the long rule of two distinguished 'heads'—Samuel Butler (1798–1836) and his successor B. H. Kennedy. Sir Philip Sidney was a 'Salopian'—also Judge Jeffreys; Charles Darwin and H. A. J. Munro were later pupils. Westminster, an Elizabethan foundation (1560), had a famous 'head' in Dr. Busby, a most vigorous wielder of the rod. Its roll is very rich in poets, Ben Jonson, Cowley, Cowper, Dryden, Southey, and George Herbert being among its pupils. Winchester College, established (1360–93) as New College by William of Wykeham, had the saintly Ken, Sidney Smith, and Arnold of Rugby as pupils. Charterhouse, founded (1611) on the site of a London monastery, was transferred to Godalming in 1872; Thackeray, a pupil, has made it famous with 'Colonel Newcome'. Among other public schools may be mentioned: Oundle School, founded by Sir William Laxton (died 1556), rebuilt in 1883, and since greatly enlarged under the headmastership of F. W. Sanderson (died 1922); Blundell's School, Tiverton, a famous West of England school, founded in 1604 by a successful draper of the town; Clifton College, Bristol, a leading 'army' school; Bedford Grammar School; King Edward's School, Birmingham; Cheltenham College; Dulwich College; Haileybury; Lancing College; The Leys School, Cambridge; Marlborough College; Malvern College; Wellington College; with such schools as those of Repton, Rossall, Sherborne, Tonbridge, and Uppingham, all establishments of high standing. Mill Hill School, near London, is largely resorted to by Non-

conformists; Stonyhurst, Lancashire, England's great Roman Catholic school, was originally established (1592) at St. Omer, Flanders.

Scottish educational houses taking rank with English public schools are: in Edinburgh, the Edinburgh Academy, in the foundation (1824) of which Sir Walter Scott took an active interest; Merchiston Castle (1833), housed in the birth-place of Napier the mathematician; and Fettes College. Loretto School, Musselburgh, was ruled on wholesome though unusual—perhaps eccentric—lines by the late Dr. Almond; while Trinity College, Glenalmond, Perthshire, had W. E. Gladstone as a leading founder. The beneficial effect of a public-school education has been brought in question by would-be reformers, upon various grounds. The curriculum has been criticized as being too classical and lacking practical utility for modern life; and it is sometimes urged that a certain supercilious self-satisfaction is to be seen in the English public schoolboy. These criticisms seem to rest upon foundations anything but sure. General experience goes to show that English public-school life, with traditions often stretching back for centuries, produces a peculiar sense, at once keen and permanent, of brotherhood, good feeling, generosity, and 'sportsmanship', the lack of which would be an incalculable loss to the race.—BIBLIOGRAPHY: C. E. Pascoc, *Every-day Life in our Public Schools*; J. G. C. Minchin, *Our Public Schools*; *Public Schools from Within*; and *The Public School Year Book* (published annually).

Public Trustee, an English public official whose business it is to act when required (1) in the administration of small estates not exceeding in value £1000; (2) as a custodian, ordinary or judicial trustee; or (3) as administrator of the property of a convict. He is a corporation sole, and may act alone or in conjunction with others, but he may not act (unless in special circumstances) in any trust where there is a business to be carried on, nor in an insolvent estate, nor in a trust for religious or charitable purposes. The office was instituted by the Official Trustee Act, 1906, and came into being on 1st Jan., 1908. On account of the security of administration afforded by it, it has steadily grown in favour. In 1921 the number of trusts controlled from the office of the public trustee approximated 15,000, with a total capital value not far short of £150,000,000 and beneficiaries aggregating 50,000. The fees charged conform to a graduated scale, and are not heavy. The offices of the trustee are at Sardinia House, Kingsway, London, W.C., and Albert Square, Manchester.

Public Works Loan Board, a Government department created in 1817 for the purpose of

advancing money to Municipal Authorities for Public Works. The staff includes a chairman and deputy-chairman (both unpaid), a paid secretary, and a legal assistant secretary. During the financial year 1920-1 loans to the amount of £61,643,748 were sanctioned, £6,555,310 being for land settlement, and £53,594,480 for purposes of the Housing Acts. During the 103 years of its existence up to 1920 the total sum advanced amounted to only £149,436,402; during the financial year 1920-1, £61,643,748 was disbursed. Interest is paid on moneys lent. In the period 1915-6 this amounted to £3, 19s. 10d. per cent; in 1916-7, £4, 9s. 6d. per cent; in 1919-20, £5, 15s. 7d. per cent; and in 1920-1, £6, 6s. 9d. per cent. Loans under the Housing Acts are secured either on local rates or on property, but mainly on the former. For working-class dwelling-houses £29,996,054 has been advanced, £904,893 going to Scotland, and the rest to England.

Publilius Syrus (often called *Publius* in error), Latin writer, so called because a native of Syria, was carried as a slave to Rome about the middle of the first century B.C. His master gave him a good education, and afterwards set him free. He excelled in writing *mimi*, or farces, which were interspersed with moral sentences, and a collection of them was used by the Romans as a school-book. A number of apophthegms, not all of them composed by him, have been published as *Publili Syri Sententiæ*. Several of them are famous, such as *Judex damnatur ubi nocens absolvitur* (the judge is condemned when the guilty is acquitted), *O vitam misero longam, felici brevem!* (O Life, long for the miserable, short for the happy), and the perpetually misquoted *Stultum facit Fortuna, quem vult perdere* (Whom Fortune wishes to destroy, she makes a fool).

Puccinia, a very large and important genus of parasitic Fungi, family Uredinæ. About half a dozen species cause the destructive disease of cereals known as 'rust', the losses from which amount to many millions of pounds sterling every year; others destroy or seriously damage various cultivated plants, such as gooseberry, plum, asparagus, mint, celery, hollyhock, carnation, &c. Many are heteroecious, e.g. *P. graminis*, the black rust of wheat, which passes a part of its life-history on the common barberry (*Berberis vulgaris*). As regards the cereal rusts at any rate, the ordinary remedial measures (e.g. spraying) are of no avail; the best line of defence appears to be the production by breeding of rust-resisting varieties which shall also be satisfactory in other respects (yield, quality, &c.), and promising advances have already been made in this direction.

Puck (O.Sw. *puke*, Icel. *puki*, an evil demon,

a word equivalent to Ir. *puca*, W. *pwca*, an imp), a mischievous fairy elf, the 'merry wanderer of the night', who is introduced into Shakespeare's *Midsummer Night's Dream*, and who was also known by the names of *Robin Goodfellow* and *Friar Rush*. He was the chief of the domestic fairies, and many stories are told of his nocturnal exploits.

Pudding-stone, or **Plum-pudding Stone**, a term now considered synonymous with conglomerate, but originally applied to a mass of flint pebbles cemented by a siliceous paste. When select specimens are cut and polished, they resemble a section of a plum-pudding, and are used for ornamental purposes.

Pud'sey, a municipal borough in the West Riding of Yorkshire, 3 miles from Bradford; served by the Great Northern Railway. Woollen and worsted goods and boots and shoes are manufactured. Pop. (1921) 14,815.

Pudukkotai, a native state of India, the third in importance of the states in political relationship with Madras Presidency. It is entirely inland, and consists mainly of an undulating plain of almost barren land, studded with hills which are crowned with ancient forts and temples. Four small rivers drain the country from west to east. The only town in the state is Pudukkotai, the capital, which is 33 miles by road south-east of Trichinopoly, and contains the palace of the rāja, an old palace, hospital, jail, college, and Residency. State area, 1178 sq. miles; pop. 412,000; pop. (town), 27,000 (mainly Hindus).

Pueb'la, an inland state of Mexico, drained by the Salado, Atoyac, and other streams. Sugar, cotton, coffee, and rice are produced in the river valleys. Puebla is the capital. Area, 12,922 sq. miles; pop. about 1,100,000.

Puebla, the third city of Mexico, capital of the state of Puebla, on the Atoyac River at an altitude of 7000 feet. It has a cathedral and a large number of religious edifices, many of them highly decorated. There are also several colleges, a museum, and a theatre. It is one of the chief seats of Mexican manufacturing industry, and its chief products are cotton and woollen goods, leather, glass, earthenware, and soap. Puebla was built by the Spaniards in 1533-4. Pop. 96,000.

Pueblo Indians are semi-civilized Indians of the Western United States in New Mexico and Arizona, some 9000 in number, living in villages in communal houses (a number of families together), and possessed of considerable skill in agriculture and the simpler kinds of manufacture. Their village communities are self-governed, and they are only nominally citizens of the United States. Their cultural equipment was derived from the ancient civilization of Mexico.

Puente-Jenil (pu-en'tā-he-nēl'), a town of Spain, province of Cordova, on the Jenil. Pop. 14,200.

Puer'peral Fever is an acute septic fever occurring in women after child-birth, and caused by infection of some part of the genital tract. The infection may arise from organisms in the genital canal before confinement—auto-infection; but more commonly it is due to organisms brought in from without by the hands or instruments of the attendant—conveyed infection. Severe bruising or tearing of the parts during labour, hæmorrhage, retained blood-clot or placental tissue, all favour its occurrence. The first symptoms usually appear between the third and fifth day of the puerperium, and of these the most constant is fever. The earlier its appearance the more serious the condition, while it may set in suddenly with a rigor or come on gradually. Along with fever there are increased pulse-rate, loss of appetite, abdominal pain, and general *malaise*. In some severe cases, however, there is at first a deceptive feeling of well-being on the part of the patient. Later septic rashes occur, and there are signs of a general septic infection with possible involvement of the lungs, causing septic pneumonia; of the heart, causing endocarditis and pericarditis; of the brain, causing mental aberration and delirium, and finally leading to meningitis. The preventibility of puerperal sepsis is now recognized by the medical profession, and the greatest care should be taken to ensure cleanliness of the hands and instruments and of those parts of the patient that are involved. Supervision of nurses and midwives as far as possible is aimed at, and though there has been improvement of late years, yet the mortality from puerperal sepsis is still relatively high, and much can still be done in the future to lower it.

Puerperal Mania is a form of insanity which develops during pregnancy and after child-birth. Suicidal and homicidal tendencies are present, and such cases are best treated in an institution with suitable observation and care of the patient. When it occurs after child-birth, it may arise in the course of puerperal sepsis, while most of the patients in whom it develops are suffering from severe exhaustion.

Puer'to-Cabello (-kā-bel'yō), a seaport of Venezuela, in the state of Carabobo. The harbour is good and provided with warehouses. Its principal exports, mainly to the United States and Germany, are coffee and cocoa. Pop. 13,000.

Puerto-Montt, a seaport-town of Chile, capital of the province of Llanquihue; served by railway to Valdivia. There is a good harbour. Wheat, timber, and leather are exported. Pop. 5000.

Pu'fendorf, or **Puffendorf**, Samuel, Baron von, German jurist, born in 1632, died in 1694. He studied theology and law at Leipzig and Jena, and in 1660 published his *Elementa Jurisprudentiæ Universalis*. In 1661 he became professor of the law of nature and of nations at Heidelberg. In 1670 he went to Sweden, became professor of natural law in the University of Lund, and brought out his chief work, *De Jure Naturæ et Gentium*, and in 1675 an abstract of it, *De Officio Hominis et Civis*. In 1677 Pufendorf went to Stockholm as historiographer-royal, and in 1686 he received a summons to Berlin from Frederick William, Elector of Brandenburg. In 1694 he was created a baron by the King of Sweden, and in the same year he died at Berlin.

Puff-adder (*Bitis arietans*), a serpent found in South and Central Africa and South Arabia. Its popular name is derived from its power of puffing out the upper part of the neck when irritated or alarmed. It is very thick, attains a length of 4 or 5 feet, and is extremely venomous. The Bushmen poison their arrows with its venom.

Puffin, the name for the marine diving birds of the genus *Fratercula*. The common puffin



Puffin (*Fratercula arctica*)

(*F. arctica*) is a native of the arctic and northern temperate parts of the Atlantic, and is often met with on the rocky cliffs of Great Britain and Ireland. It is about a foot in length, and from the singular shape and enormous size of its bill, which is striped with orange upon bluish-grey, is often called the sea-parrot or the coulter-neb. The plumage is glossy black, with the exception of the cheeks and under-surfaces, which are white. It breeds upon rocks and in the rabbit-warrens near the sea, and lays one egg, which is white. It lives on fish, crustacea, and insects, and is a gregarious and migratory

bird. It is replaced in the Pacific by a related species, *F. corniculata*.

Puget Sound (pū'jet), an inlet on the north-west coast of the state of Washington, United States, forming the south-west continuation of Juan de Fuca Strait, with which it is connected by Admiralty Inlet. On its shores are Seattle and Tacoma.

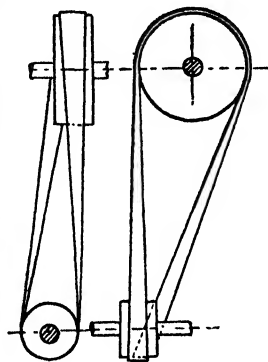
Pugin (pū'jin), Augustus Welby Northmore, architect, born in 1812, died in 1852. He was the son of Augustus Pugin (1762–1832), from whom he imbibed a love of Gothic architecture, to promote the revival of which became early the object of his life. In 1834 he became a Roman Catholic, and he designed a large number of ecclesiastical buildings for that communion, among them a church at Ramsgate, which was built at his own expense. He assisted Sir Charles Barry in the designs for the new Houses of Parliament, especially in those for their interior fittings and decorations. *The Contrasts, or a Parallel between the Architecture of the 15th and 19th Centuries* (1836); *The True Principles of Pointed or Christian Architecture* (1841); and *The Glossary of Ecclesiastical Ornament and Costume* (1844), are among his principal works.

Pug-mill, a machine for mixing and tempering clay. It consists of a hollow iron cylinder, generally set upright, with a revolving shaft in the line of its axis, carrying a number of knives projecting from it at right angles, and arranged in a spiral manner. The clay is thrown in at the top of the cylinder, and by the revolution of the shaft is brought within the action of the knives, by which it is cut and kneaded in its downward progress, and finally forced out through a hole in the bottom of the cylinder.

Pulci (pul'chē), Luigi, Italian poet, born in 1431, died in 1487. He lived in intimacy with Lorenzo de' Medici and his literary circle. His poem *Il Morgante Maggiore*, in which he relates the adventures and exploits of Rinaldo and the giant Morgante, while containing both serious and pathetic passages, is on the whole a burlesque on the romantic epics of his predecessors. Part of it was translated by Byron.

Pulley, a simple wheel or disc mounted concentric with its shaft and driven by means of a belt. Pulleys are commonly made of cast iron, built up from steel pressings or wood. When power is transmitted, there is a considerable difference in the tension of the belt on the two sides of the pulley. The relationship between the tight-side tension, T_1 , and the slack-side tension, T_2 , is given by $T_1/T_2 = e^{\mu\theta}$, where e is the base of the hyperbolic logarithms, μ is the coefficient of friction between belt and pulley, and θ is the angle subtended by the arc of contact of the belt at the centre of the pulley. The driving pull is given by the difference of T_1 and T_2 , and the

horse-power transmitted is given by the formula $(T_1 - T_2)2\pi NR/33000$, N being the number of revolutions per minute, R the radius of the pulley in feet, T_1 and T_2 the tensions in pounds. It is common to make the rim crowned or slightly raised towards the middle, to ensure that the belt will run on the centre of the rim. The pulley should be at least an inch wider than the belt. If the belt-drive is open, the two shafts connected by it will run in the same direction, but if it is crossed, the motion will be reversed. The part of a belt which is advancing towards a pulley must move in the plane in which the pulley is rotating. When it is difficult to arrange a simple belt-drive between two shafts, which may not be parallel, the use of idle or jockey pulleys may make the problem one easy of solution.



Belt Drive with Shafts at right angles

Thin flexible-steel belts are sometimes used in workshop practice. Chains are used for drives where slip must be avoided. See *Power Transmission; Tackle*.

Pulmonata, an order of gastropod molluscs, in which the respiratory organ is a cavity formed by the adhesion of the mantle by its margin to the neck of the animal. The greater part of them are terrestrial, among these being the land snails and slugs.

Pulpit (Lat. *pulpitum*, platform, stage), an elevated stand for the delivery of sermons. It is called in French *chaire*, and in German *predigstuhl*, and is derived from the custom of the first Christian ages, when the bishops delivered their addresses and preached from the *cathedra*. The immediate predecessor of the present pulpit was the *ambo* (q.v.), but in the twelfth century movable pulpits were employed for the delivery of sermons. As early as the thirteenth century pulpits were built in Italy, and the most noteworthy are those at Pisa built by Nicola Pisano in 1260, and at Pistoia by his son Giovanni. Renaissance pulpits are to be found in Italy, such as that in Santa Croce, Florence. Striking pulpits are also to be found in Belgium, such as that in the church of St. Gudule at Brussels, and in the church of St. Andrew at Antwerp.

Pulque (pulk), the *vin du pays* of Latin America, made from the juice of various species of agave, pleasant and harmless until after

protracted fermentation, when it becomes an intoxicant. A kind of brandy is also distilled from it. To the European palate it is sour and unpleasant, somewhat resembling a dilute solution of sulphuric acid.

Pulse, leguminous plants or their seeds, including all kinds of beans, peas, lentils, &c. The considerable proportion of nitrogen which they contain makes them very nutritious, and on that account they are much eaten, with or without rice, in India, where the chick-pea (*Cicer arietinum*) is one of those very largely used. The Hebrew word translated pulse in the Authorized Version of the Bible (*Dan. i, 12, 16*) probably means edible seeds in general.

Pulse, the throbbing movement of the walls of blood-vessels, from the passing waves of blood due to the beats of the heart. It is limited in healthy conditions to the arteries. In the newly-born child the healthy pulse registers 130 to 140 beats a minute, at two years of age 105, at ten years about 90, at fifteen to twenty about 70, while in old age it may sink to about 60. In females it is somewhat higher than in males, and during certain fevers it sometimes reaches 140 beats per minute. In arteries which lie immediately under the skin it can be felt with the finger, as is the case with the radial artery, the pulsation of which is very perceptible at the wrist. The state of the pulse is therefore an indication of the force and frequency of the action of the heart, and of the fullness of the vessels.

Pultusk', a town of Poland, on the Narev. The Saxons were defeated there by Charles XII in 1703, and the Russians by the French in 1806. Pop. 19,000.

Pulu (pulu fibre), a silky fibrous substance obtained from ferns of the genus *Cibotium*, and exported from the Sandwich Islands (Hawaii); it is often termed vegetable silk, and is used for stuffing mattresses, &c. Other species growing in the East Indies, Mexico, &c., yield a similar substance.

Pu'mice, a substance frequently ejected from volcanoes, of various colours, grey, white, reddish-brown or black; hard, rough, and porous; blocks float on water; and it resembles the slag produced in an iron furnace. Pumice is really a loose, spongy, froth-like lava, and is formed during the escape of steam and other gases from highly siliceous and therefore viscid lavas. It is often found floating on the sea far from the vent of origin. The pores being generally in parallel rows, it seems to have a fibrous structure. It is used for polishing ivory, wood, marble, metals, glass, &c.; also for smoothing the surfaces of skins and parchment.

Pumpkin, a climbing plant and its fruit, of the genus *Cucurbita*, the *C. Pepo*, nat. ord.

Cucurbitaceæ or Gourds. The pumpkin came originally from India, but is at present cultivated in most parts of Europe and in America. The fruit is red, and sometimes acquires a diameter of 2 feet. There are two varieties of the plant, one with roundish, the other with oblong fruit. The fruit is eaten in a cooked state.

Pumps, mechanical devices for the raising of water or other fluid from a low level to a higher

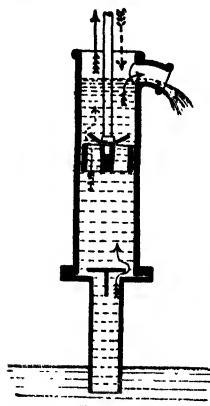


Fig. 1.—Bucket Pump

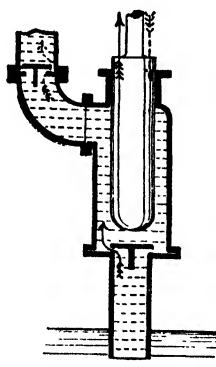


Fig. 2.—Plunger Pump

one, or to raise the pressure upon it so that it may be passed into a vessel under pressure. The hydraulic prime movers, such as overshot and breast wheels, and pressure turbines, when reversed become types of pumps.

The *scoop wheel* or reversed breast wheel is used to lift drainage water in fen districts. Overshot wheels become *chain-and-bucket pumps* when reversed. In Holland an inclined shaft with one or more helices, which is rotated in a closely fitting tube, is used to raise water against heads which do not exceed 10 feet. This appliance is known as the *screw pump* or *archimedeian screw*.

The oldest pumping plant is the simple *bucket pump*, which is ascribed to Ctesibius of Alexandria and dates from 250 B.C. In this type a piston is fitted to work air-tight within a hollow cylinder or barrel, and is provided with a valve which opens upwards. There is another valve at the foot of the barrel, which also opens upwards and gives communication between the pump and the suction pipe. As the piston is raised the air below it becomes rarefied until water is drawn up through the inlet valve. When the air is exhausted, the water passes through the valve on the piston every down-stroke, and is raised to the delivery pipe on every up-stroke. When the water is to be discharged from the cylinder against a pressure, non-return valves are installed in the

delivery pipe, and the plant is then known as a *force pump*. When greater pressures are required, a plunger is used instead of the bucket piston, which under such conditions would leak considerably. This *plunger pump* may be made double-acting, either with a single plunger or a combination of two simple pumps. Another type has a moving part consisting of both *bucket piston* and *plunger*, with cross-sectional areas in the ratio of two to one.

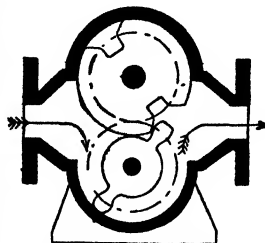


Fig. 3.—Rotary Pump

Rotary pumps of the drum type have the advantage of positive action comparable with that of the reciprocating pump, and, like the centrifugal type of pump, they have a continuous delivery. The mode of operation of such devices can be clearly understood from the illustration. The water is trapped by the rotors, and is driven towards the outlet as they turn. One great difficulty in the operation of such pumps is the maintenance of tightness.

The *centrifugal pump* was introduced to meet the demand for high efficiency under low heads of water. The rotor consists of circular side plates enclosing a series of curved blades. The water pipe is connected to a part of the pump having communication with the central part of the rotor. Velocity is given to the water by the blades of the moving system, and its magnitude, which depends upon the speed of the rotor and the form of the blades and pump chamber, is the factor on which the height the water can be raised depends.

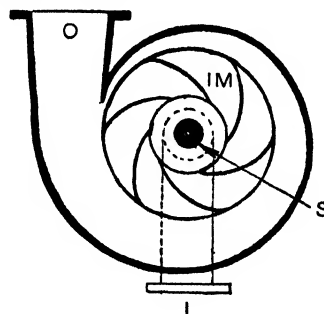


Fig. 4.—Centrifugal Pump

I, Inlet. O, Outlet. IM, Impeller. S, Spindle.

Centrifugal pumps were greatly improved by Professor Osborne Reynolds, whose work made possible the construction of the high-lift pump. With a number of impellers, through which the

water is passed in sequence, very high lifts, such as over 1000 feet, can be obtained with efficiencies as high as 75 to 80 per cent. The success attained in designing centrifugal pumps

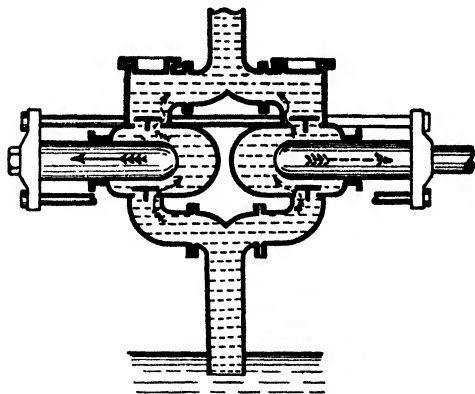


Fig. 5.—Horizontal Double-acting Ram Pump (opposed plungers)

to meet the requirements of any particular pumping work has been very great, and this type is replacing the reciprocating pump for use in all fields but those where small volumes of water are to be raised to great heights. The kinetic energy of moving water in a pipe is used in the *hydraulic ram* to pump part of the water to a height greater than the head of supply. The water is set in motion by opening the waste valve. The velocity of flow increases until the weight of the waste valve is overcome and it is sharply closed. The sudden stoppage of the flow of the water is followed by the impact of the water against the delivery valve, which is opened, and a portion of the liquid passes through. In this way a large flow of water with small head is used to pump a smaller quantity of water against a greater head. Such a device is useful in supplying water from a low stream to a house on a hill.

A pump which has been considerably developed since its introduction in 1909 is the *Humphrey pump*, in which kinetic energy is given to the water by the explosion of gases. A mixture of gas and air is admitted through the valve in the top of the explosion chamber. Water enters the pipes from the supply-tank through the valves. When the gas is ignited and the explosion takes place, the water is swept through the pipes at great velocity and out at the delivery. The backward surge of whatever water is left is used to drive the exhaust gases out of the explosion chamber and leave it clear for the introduction of another explosive charge. There is a large installation of these pumps at the Chingford works of the Metropolitan Water

Board. Each pump delivers 40 million gallons of water a day, and is of about 250 to 300 horsepower. The pumps are supplied with producer-gas made from anthracite. For smaller sizes a form of gas pump has been introduced by Humphrey, in which the long water column is replaced by a heavy metallic mass attached to the piston. The application of steam pressure to the surface of water within the pump chambers is made use of in the *pulsometer* to drive the water through the delivery-pipe system, and the later condensation of the steam creates a partial vacuum for the suction of a further supply of water. The pumps have two chambers, which are used alternately to obtain a continuous discharge. Compressed air is used to raise water from deep wells. The air is introduced into a pipe the foot of which is immersed in the water to be lifted. Alternate plugs of air and water pass up the 'rising main' or water outlet.—BIBLIOGRAPHY: A. H. Gibson, *Hydraulics and its Applications*; E. C. Bowden-Smith, *The Efficiency of Pumps and Ejectors*; E. W. Sargant, *Centrifugal Pumping Machinery*.

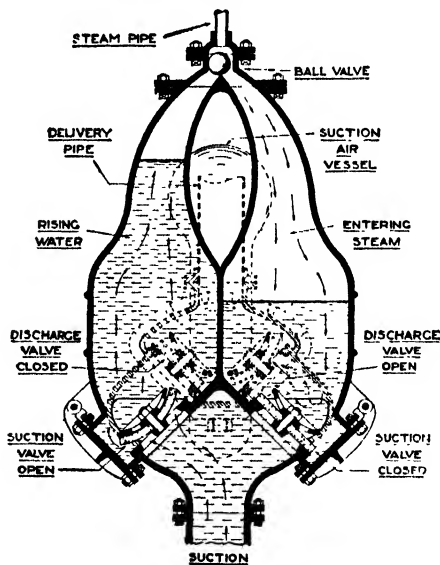


Fig. 6.—Pulsometer

Punch, or *The London Charivari*, a weekly illustrated paper, has, since its first appearance in 1841, well justified Mark Lemon's claim that it "established, if it did not found, a school of current wit and humour". The paper originated in a suggestion made to Henry Mayhew by Last, a London printer, for the production of a publication somewhat on the lines of the *Paris Charivari*. During the first few months of its life, under the co-editorship of Mayhew and

Mark Lemon, *Punch* threatened to be little more than a *succès d'estime*; happily, on the available funds becoming exhausted, the proprietorship was transferred to Messrs. Bradbury & Evans, Lemon being made sole editor. Its first annual almanac (1841) was written in the Fleet Prison by Dr. Maginn, under circumstances which doubtless suggested to Thackeray the similar position of Captain Shandon in *Pendennis*. Since that date hardly a famous British humorist or artist of a certain type has failed to have a place upon the paper's staff or to contribute to its pages. Lemon remained the editor until his death in 1870, when Shirley Brooks took his place, to be succeeded by Tom Taylor in 1874. Sir Francis Burnand took the chair in 1880, retained it till 1906, and was followed by Mr. (now Sir) Owen Scaman, the present editor. The literary staff has included such writers as Douglas Jerrold, who contributed the immortal *Mrs. Caudle*; Thackeray (*Snob Papers* and *Jeames's Diary*); Gilbert & Beckett; Hood (*The Song of the Shirt*); Tennyson (*The New Timon*); Sir Henry Lucy ('Toby, M.P. '); T. Anstey Guthrie ('F. Anstey '); and E. V. Lucas. Among its many famous artists John Leech may be first named; but Richard Doyle designed the now familiar present cover; Hablot K. Browne was a frequent contributor; and Tenniel's first published cartoon appeared in the paper and led to his taking charge of this leading feature for just half a century. Other distinguished draughtsmen, past and present, include Charles Keene, George du Maurier, Linley Sambourne, Bernard Partridge, L. Raven-Hill, and George Belcher. *Punch* largely owes its unrivalled, and indeed unchallenged, position to the uniformly wholesome and refined nature of its humour, both literary and pictorial, and also to its strict impartiality, all shades of politicians being in turn the targets for its friendly fun.—Cf. M. H. Spielmann, *History of Punch* (1895).

Punch and Judy, a familiar puppet-show of, almost certainly, Italian origin, the equivalent of the French *guignol*, has now been popular in Britain for some two and a half centuries. The derivation of Punch (diminutive of *Punchinello*; It. *Polichinello*), the name of the hook-nosed, hunchbacked leading character in the drama, has been the subject of much research and more speculation, but it still remains obscure. Some authorities state that an amateur humorist, one Puccio d'Aniello, from the neighbourhood of Naples, joined a troupe of strolling players and created the part; but d'Aniello's claim is disputed in favour of that of numerous rivals, each with a more or less suggestive name. The theory sometimes put forward that Punch is derived from Pontius Pilate, and the name of

his long-suffering wife Judy from Judas the betrayer of Christ, may be dismissed as most improbable. It is possible, however, that the name has its real root in *pulcino* and *pulcinetto*, the Italian terms for a young chicken, sometimes used familiarly as words of endearment to a child, and hence applied also to a puppet. *Punch* probably dates from the early years of the seventeenth century, and had certainly made its way to France by the time of Louis XIV. The fact that the French regarded a hunchback as a type of caustic wit made the new arrival peculiarly welcome; the wits and politicians hailed its advent eagerly, and at once used it as a mouthpiece for attacks upon unpopular characters. The show probably crossed to this country in the train of Charles II returning from exile in 1660; though some believe it to have come to England with French Huguenots at a much earlier date. Evelyn mentions a performance of an Italian puppet-show in 1667; while in 1669 Pepys speaks of a stout child being called 'Punch' by its parents as a common name for all that is thick and short. With the arrival of William of Orange and his numerous compatriots in 1688 the show appears to have become still better known, a fact to be explained by the peculiar skill of the Dutch in the manipulation of all puppet-shows. *Punch* was exhibited at Bartholomew Fair in 1703, and seven years later was a leading item in a puppet-show at Covent Garden, under the direction of Powell. The period at which 'Dog Toby' came to be a member of the troupe remains unknown; Powell at one time employed a trained pig, while French exhibitors not seldom used a cat. At the present time *Punch*, *Judy*, the policeman, &c., form an exhibition somewhat shorn of its original magnificence; for the old *Punch* would seem to have been on familiar terms with such distinguished characters as the Seven Champions of Christendom; he further hoodwinked and defied the Holy Inquisition, and he sat upon the Queen of Sheba's knee. For an account and text of the drama see Payne Collier's *Punch and Judy*, with George Cruikshank's illustrations (1st edition, 1828; 7th edition, 1890).

Punctuation, the art of employing signs by which the parts of a writing or discourse are connected or separated as the sense requires, and the elevation, depression, or suspension of the voice indicated. Punctuation serves both to render the meaning intelligible and to aid the oral delivery. Our present system of punctuation came very gradually into use after the invention of printing, the Venetian printers, the Manutii, contributing materially to its development. The principal points used in English composition are the *comma* (,), *semicolon* (;), *colon* (:), *period* or *full stop* (.), *note of interrogation* (?), *note of*

exclamation or *admiration* (!), *dash* (—), and *parenthesis* (). The *comma* marks the smallest grammatical division in a sentence, separating the several members of a series, or the subordinate clauses and the main clause. The *semicolon* indicates a longer pause than the comma, but requires another member or members to complete the sense. The *colon* denotes a still longer pause, and may be inserted when a member of a sentence is complete in itself, but is followed by some additional illustration of the subject. The *period* indicates the end of a sentence, and is also used after contracted words, and sometimes after Roman numerals. The *note of interrogation* is placed at the end of a direct interrogatory sentence. The *note of exclamation* or *admiration* is placed at the end of such words or clauses as indicate surprise or other emotion. The *dash* is employed where a sentence breaks off abruptly, and the subject is changed; where the sense is suspended, and is continued after a short interruption; after a series of clauses leading to an important conclusion; and in certain cases to indicate an ellipsis. The *parenthesis* encloses a word or phrase introduced into the body of a sentence, with which it has no grammatical connection.

Pu'nica, a genus of plants which consists only of a single species, the pomegranate (*P. granātum*). See *Pomegranate*.

Punic Wars, a series of wars waged between Rome and Carthage, the first 264–241 B.C.; the second 218–202 B.C.; and the third, which ended with the destruction of Carthage, 149–146 B.C. See *Rome*.

Punishment, a penalty inflicted on a person for a crime or offence, by the authority to which the offender is subject; a penalty imposed in the enforcement or application of law. The punishments for criminal offences now known to the English law are death by hanging, penal servitude, imprisonment with and without hard labour, solitary confinement, detention in a reformatory or industrial school, discipline in a Borstal institution, subjection to police supervision, fines, whipping, and putting under recognizance. Penal servitude consists in keeping the offender in confinement and compelling him to labour, as directed in several statutes passed since the year 1853. There are three kinds of imprisonment: (1) that of a first-class misdemeanant, who is allowed to maintain himself, to procure food, wine, clothing, &c., and to follow his usual occupation if it does not interfere with the prison regulations; (2) without hard labour, in which case the visiting justices provide for the employment of the prisoner, subject to the condition that no punishment for neglect of work is to be inflicted except by an alteration in the prisoner's diet; (3) with

hard labour for not more than ten or less than six hours daily, and as ordered by the justices in sessions with the approval of the Home Secretary. In cases (2) and (3) there may be a separate confinement of the prisoner. Fines are in most cases regulated by the statutes imposing these penalties. As regards whipping, in the case of offenders under sixteen only a birch-rod may be used, and not more than twenty-five strokes be given; in that of offenders above sixteen not more than fifty strokes, and the sentence must specify their number, and the instrument with which they are to be inflicted. When whipping is ordered on summary conviction before the justices, not more than twelve strokes are to be inflicted on offenders under fourteen, and those with a birch-rod; under the age of ten the number of strokes is restricted to six. Detention in a reformatory school may be ordered for not less than three nor more than five years (but not to continue after nineteen years of age) in the case of juveniles between twelve and sixteen years of age who have committed offences punishable with penal servitude or with imprisonment. Offenders under twelve years, and those over that age but not over fourteen years, who have not been previously convicted, may be sent to an industrial school until sixteen years of age. Persons between sixteen and twenty-one years of age liable to penal servitude may be sent to a Borstal institution for a term of one to three years. In cases of felony and of certain specific misdemeanours, when a previous conviction for a similar offence is proved, the sentence may include police supervision for seven years or less, to commence at the expiration of the offender's term of imprisonment. On its expiry he must notify to the police within forty-eight hours his place or any subsequent change of residence, and report himself once a month, a breach of any of these regulations rendering him liable to imprisonment for twelve months with or without hard labour. When the offender is ordered to find recognizances, personal or other, he may, in default, be imprisoned.

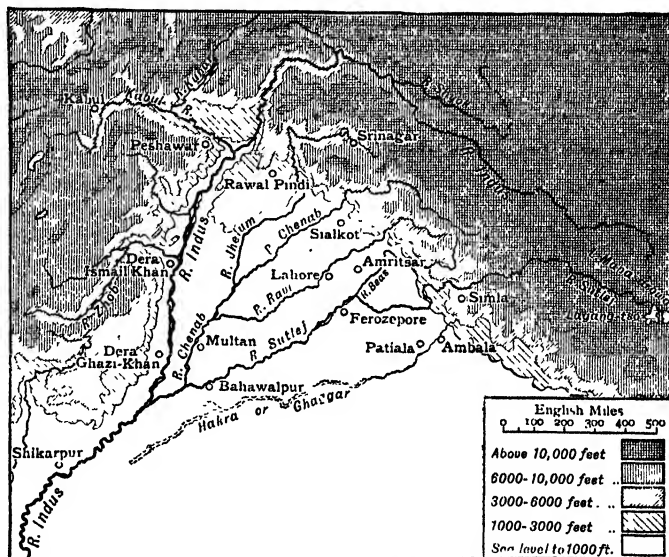
Punishments in the army are inflicted under the Army Act of 1881, Articles of War, and the King's Regulations. A commissioned officer must be tried by court-martial, which may sentence him to death, or cashier him, or place him at the very bottom of the officers of his grade. Privates may for minor offences be ordered short imprisonments, or punishment-drill, or stoppage of leave or pay. For grave offences they are tried by court-martial, and may be sentenced to dismissal from the service, or to imprisonment, to penal servitude, or to death.

Punishments in the navy are regulated by the Naval Discipline Act of 1866. For officers the

chief additions to the punishments inflicted in the army are forfeiture of seniority for a specified time or otherwise, dismissal from the ship to which the offender belongs, and reprimand more or less severe. For men the punishments in the case of grave offences are of the same character as in the army, flogging having been now abolished. For less serious offences there is a system of summary punishments, including short terms of imprisonment which can be awarded by captains of ships under the regulations issued from time to time by the Lords of the Admiralty.

Punjab, or **Panjab** (the name means 'Five Rivers'), a province of British India, so called because it was the region intersected by the five tributaries of the Indus, the Sutlej, the Beas, the Ravi, the Chenab, and the Jhelum. The present province of the Punjab, however, is larger than the Punjab proper, and is bounded west by Afghanistan, Baluchistan, and the North-West Frontier Province; north by Kashmir; east by the United Provinces; and south by Sind and Rājputāna. The area, exclusive of the connected native states, is 99,222 sq. miles; the population, according to the census of 1921, 20,678,393 (or 208 per square mile). It consists of twenty-eight British districts and thirty-four native tributary states. For administrative purposes it is divided into the five commissionerships of Delhi, Jalandhar, Lahore, Rawal Pindi, and Derajat. Lahore, situated near the centre of the province, is the capital of the Punjab, but its principal city is Delhi, the ancient metropolis of the Mogul sovereigns of India. Since 1902, when the Peshawar division was separated from the Punjab to form with other territories the North-West Frontier Province, the Punjab consists almost wholly of extensive plains. These are divided into eastern and western, which may be defined as lying east and west of the meridian of Lahore. The eastern plains include the most fertile and populous portion of the Punjab, with the three great cities of Delhi, Amritsar, and Lahore. Their population is largely urban; trade and manufactures flourish, and the cultivable area is generally under the plough, with the exception of the south-western portions, where flocks and herds pasture in ex-

tensive jungles. The western plains, on the contrary, and with the exception of a comparatively narrow zone which is fertilized by irrigation, and which produces some of the finest wheat in the world, are covered by stunted bush, with short grass in dry seasons, and by saline plants which afford nourishment to great herds of camels. These, with cattle, sheep, and goats, are tended by a nomad population. The difference between the inhabitants of these two series of plains is also very marked, those in the eastern partaking of the character of the Hindu inhabitants of India, while those in the western resemble more the Mussulman peoples of the trans-Sulciman country. Though numerically small, the Sikh



The Five Rivers

element in the population is very important. The Sikhs constituted the dominant class when the Punjab became British, and they still compose the mass of the gentry between the five rivers. One of the most important products of the Punjab is rock-salt. In addition to the manufactures common to the rest of India, the industries of the Punjab include such special products as the silks of Multan and the shawls and carpets of Lahore. The province enjoys an extensive trade with adjacent countries, and sends its products to Delhi by railway, and by the Indus and the Indus Valley Railway to Sind and the sea. Its imports from Britain are chiefly piece-goods, cutlery, and other metal works.

The Punjab has had a rather eventful history from the time of Alexander the Great downward. After being long held by rulers of Afghan or Tatar origin, the Sikhs under Runjit Singh

established themselves there early in the nineteenth century. Afterwards the country fell into a very distracted state; its Sikh rulers came into collision with the British, and after the second Sikh War, in 1849, the country was brought under British administration.—BIBLIOGRAPHY: J. Douie, *The Punjab, North-West Frontier Province, and Kashmir*; A. Latifi, *The Industrial Punjab*; and article in *Imperial Gazetteer of India* (vol. xx).

Puno, a department of Peru, situated between Arequipa and Cuzco departments and Bolivia, and including the greater part of Lake Titicaca. Excepting for the Bolivian traffic it depends entirely for its outlet on Mollendo and Arequipa. Copper, silver, lead, antimony, salt, and petroleum are found, and there are deposits of borax in the province of Azangaroo. Sheep, cattle, hides, skins, llama, alpaca, vicuña, sheep wool, dried meat, cereals, and other agricultural produce; coffee, bark, coca leaves from Sandia and Carabaya, and coal (undeveloped) are among the products. The cattle of the department are exported to Lima via Mollendo. Puno is the capital. Area, 41,198 sq. miles; pop. about 500,000.

Puno, a city of Peru, capital of the department of Puno, stands on the west shore of Lake Titicaca at an altitude of 12,600 feet. It is connected by railway with Arequipa (351 kilometres), and with Guaqui (120 miles) by railway steamer across Lake Titicaca. Pop. 12,000.

Punta Arenas, the capital of the Chilean territory of Magallanes, in the Strait of Magellan, the most southerly town in the world. There is a wireless station, but Punta Arenas has always existed as a coaling-station and as a centre of distribution for the Falkland Islands, &c., and the adjacent archipelago. Gold, copper, and coal are found in the vicinity, and much meat, wool, hides, timber, and grease are exported. Pop. 12–13,000.

Punta Arenas, the principal port of Costa Rica, Central America, on the Pacific Coast, Gulf of Nicoya. Pop. 3000.

Pupil-teacher, a boy or girl engaged by the managers of a public elementary school to assist in the general work of the school, while receiving instruction in ordinary educational subjects, as well as theoretical and practical training in the art of teaching. For a rural school the normal period of appointment is four years, and candidates should be from fourteen to sixteen years of age. When the instruction is given in a pupil-teacher centre, the pupil-teacher must be over sixteen and not over eighteen at the date of appointment, and the regular period of employment is two years. Candidates for the teaching profession are grouped by the Board of Education, according to the type of their preliminary

instruction, under four headings, as shown in the accompanying table, which gives the total number of teachers recognized for the first time by the Board in the years stated.

Type of Intending Teachers.	1917–8.	1918–9.	1919–20.
Bursars	3,180	3,133	3,538
Pupil-teachers instructed in centres	1,498	1,243	1,099
Pupil-teachers not instructed in centres	409	494	489
Student-teachers who had not been bursars	356	404	471
Totals	5,443	5,274	5,597

In Scotland, under the regulations of 1906, the pupil-teacher system in the strict sense was abolished, and there are now, among intending teachers, (1) candidates on probation (twelve to fifteen years); (2) junior students (fifteen to seventeen or eighteen years); and (3) students in full training (course at least two years).

Puppets and Puppet-plays. Puppet-plays are dramatic performances in which human actors are replaced by mechanical figures of wood or pasteboard, usually small in size, their movements and gestures being produced by means of strings or wires manipulated by a concealed operator. The comparatively modern name of *marionettes*, applied to such figures, is generally held to be a corruption of *mariolettes*, the term for small images of the Virgin Mary. Other authorities derive it from *morio* (It., ‘a fool or buffoon’); while it has alternatively been connected with an Italian named Marion, who, in the reign of Charles IX, introduced these shows to France from Italy, where, under the name of *fantoccini*, puppets had long been popular. Marionettes are first so called by Boucher (1584), so that the theory seems not ill founded. The only marionette exhibition now common in England is that of the familiar Punch and Judy (q.v.); but puppet-shows have long been popular, and are undoubtedly of very great antiquity. Jointed puppets have been found in Egyptian tombs, while in ancient Greece the puppet-player Pothcinos had a remarkable vogue in Athens. It was, however, probably in India that the puppet, like the fairy-tale, was earliest known. In the collection of Kashmiri tales, compiled from ancient sources by the eleventh-century writer Somadeva, there is mention of mechanical puppets worked by means of a wooden peg; some flew in the air, brought water, danced, and even spoke. Others were worked by strings, the operator being known as the *sūradhār* (‘string-puller’). This word is still applied to a stage-

manager, a fact suggesting that the puppet-play was the earliest form of stage exhibition. No single written puppet-play has come down to us from antiquity, and it is probable, not only that such exhibitions consisted largely of improvisation, but that they were passed on by oral tradition from one generation to another—partly, no doubt, in order to avoid the danger of their being ‘pirated’. From India the art of manipulating marionettes passed into Persia; also to the Farther East, including Java, where these shows became extremely popular. From Persia the art gradually penetrated to Europe, where, as in its original home, it was for long largely in the hands of the gipsies. In 1812 the English traveller Ouseley witnessed a gipsy puppet-show in Tabriz. During the first half of the last century gipsy exhibitors wandered through Moldavia between Christmas and Lent, and showed their plays; at the time of the Russo-Turkish War (1828–9) the performance always closed with a combat between a Turk and a Cossack, one or the other losing his head in accordance with the latest victory reported from the ‘front’. The exhibitor of marionettes, other than the gipsy, was often a self-educated man with a turn for mechanics. Jean Brioché, who, with his attendant monkey Fagotin, was highly popular under Louis XIV, was a tooth-drawer; the German Reibehand (flourished 1734) had been a tailor. A partnership of two was a frequent arrangement, one member of the firm dressing and manipulating the puppets, the other supplying the ‘libretto’. Successful French exhibitors were Carolet and Bertrand; while Goethe admitted that the exhibition of *Faust* in Berlin (1804) by Dreher and Schütz first suggested his great drama to his mind. Even Le Sage did not disdain to write for marionettes, nor, in our own day, Maurice Maeterlinck. The puppet-show was flourishing in England in the time of Chaucer, and was later a popular feature of Bartholomew Fair, where, in 1667, Pepys noticed Lady Castlemaine enjoying this show. The earlier plays performed were often such Bible narratives as lent themselves readily to stage representation, as, for example, *Jonah and the whale*. The chief English exhibitor of the early eighteenth century was Powell, an exceedingly clever mechanician. After him came Pinkethman and Crawley, the last-named producing a striking scene of Noah leaving the ark at the head of the procession of animals. Still later Yates showed wax figures of almost life-size, and towards the close of the century Flockton produced an exhibition containing five hundred separate figures working at different trades. As late as 1830–40 Brown toured the country fairs of England exhibiting the battle of Trafalgar, Napoleon crossing the Alps at the

head of his army, &c.; while Chapman gave a realistic study of Grace Darling’s rescue of the crew and passengers from the wrecked *Forfarshire*. Such exhibitions, like those of the original puppet-shows in general, appealed chiefly to the masses; but in 1876 a marionette exhibition at the Kasperle Theatre, Vienna, was favoured with Imperial patronage, and a few years later Rivière, at the Chat Noir, Paris, revived the puppet-show with much success. George Sand established at her country house a private theatre for this purpose. *Ombres chinoises* form a variety of puppet-show in which the shadows of the figures are seen thrown upon a screen.—BIBLIOGRAPHY: Charles Magnin, *Histoire des marionnettes en Europe*; L. de Neuville, *Histoire des marionnettes*; Maindron, *Marionnettes et Guignols*; R. Pischel, *The Home of the Puppet-play* (a published lecture).

Pur’beck, Isle of, south of Dorsetshire, a peninsula so separated from the mainland on the north by Poole Harbour and the Frome as to be connected with it by only a very narrow isthmus. It is about 12 miles long by 7 miles broad. The prevailing rock is limestone.

Purbeck Beds, the uppermost members of the British Jurassic system, or according to other writers the base of the Wealden formation; deriving their name from the peninsula of Purbeck, where they are typically displayed. They consist of argillaceous and calcareous shales, and freshwater limestones and marbles, and are altogether 300 feet thick. They are noted for their layers of fossil vegetable earth (dirt-beds), enclosing roots, trunks, and branches of cycads and conifers, and for the Purbeck Marble (q.v.).

Purbeck Marble, or **Purbeck Stone**, an impure freshwater limestone formed of the remains of the gastropod *Vivipara* (*Paludina*), occurring in the Purbeck Beds. It takes on a good polish, but is deficient in durability under exposure to the air, and has hence lost much of its favour as a building-stone. It is much used for slender shafts in the interior of Gothic buildings, for which purpose it answers well.

Pur’cell, Henry, one of the greatest and most original of English composers, was the most famous of several musicians of the name all included within three generations of the same family. They lived in the seventeenth and early part of the eighteenth century. As so often happens in connection with great men of that and earlier periods, the definitely established facts of Purcell’s life are comparatively few, notwithstanding that he was fortunate enough to be understood and appreciated in his lifetime. He was born in London in 1658 or 1659, and began his musical career as a chorister of the Chapel Royal. When his voice broke, he studied

composition with John Blow, at that time organist of Westminster Abbey, and his earliest compositions are conjecturally assigned to this period. At the age of twenty-one he succeeded his master as organist at the Abbey, retaining the post till his death, when Blow resumed his former duties. It is generally understood that Blow voluntarily resigned his post to make room for Purcell, thus gracefully acknowledging his genius, but the story lacks confirmation. About this time Purcell married, and two years later, on 14th July, 1682, he became organist of the Chapel Royal. He was thus throughout his short career closely identified with the doings of royalty, and *Welcome Songs* and *Birthday Odes* form a considerable proportion of his large output. He died in 1695, and was buried on 26th Nov. in Westminster Abbey. On a pillar near his grave a tablet was put bearing the following inscription: "Here lyes Henry Purcell Esq.; who left this life, and is gone to that blessed place where only his harmony can be exceeded".

Purcell, though he died at the early age of thirty-seven, left behind him a large quantity of music which included sacred and secular vocal music both solo and concerted, instrumental music for organ, for harpsichord, and for various combinations of instruments, and incidental music to many plays. There are among his dramatic works several which are entitled to be called real operas, the chief of these being *Dido and Æneas*, a remarkable work which may fairly be regarded as the first successful English opera. Among other works of special fame may be mentioned the *Golden Sonata*, one of a series of ten published posthumously and written for "violins and basse: to the Organ or Harpsichord". Twelve sonatas for the same combination had been issued in 1683 as Purcell's first published composition. Mention should also be made of the *Te Deum* and *Jubilate* in D written in 1694, and performed annually in London for many years after the composer's death. It was revived at the Purcell bicentenary in 1895, and has had some more recent performances.

In his melodies Purcell's manner of musical expression is typically English, for while the melodic line is always flowing and beautiful, it also possesses what can best be described as a 'forthright' quality which makes it highly characteristic. This is well illustrated by the rugged accentuation which prevails in *Fairest Isle* and *Come if you dare*. His music is also pre-eminently notable for the massive effect of his scoring in choral work, which may be a common enough achievement to-day, but was new when he wrote. In his power of dramatic expression he was unrivalled in his time, and the inherent vitality of his music is such that it retains after more than two centuries all the

freshness and charm that it had when it was written.

Purchas, Samuel, was born at Thaxted, in Essex, about 1575, died in 1626. Educated at Cambridge, he took orders, and in 1604 became vicar of Eastwood, in Essex. From 1614 to 1626 he was rector of St. Martin's, Ludgate Hill, London, a position favourable to the pursuit of his multifarious researches. The MS. remains of Hakluyt having come into his hands, he gave to his work, published in 1624, the title *Hakluytus Posthumus, or Purchas his Pilgrims, containing a History of the World in Sea Voyages and Lande Travells by Englishmen and others*, which is valuable as containing the narratives of voyagers, explorers, and adventurers as written by themselves. The *Pilgrims* has been much utilized by subsequent compilers of voyages and travels. He also wrote *Purchas his Pilgrimage* (1613).

Purchase, a system, now abolished, by which more than half the first appointments and much of the subsequent promotion of officers in the British army used to be effected. The prices of commissions were fixed as follows: £450 for a cornetcy or ensigncy; £700 for a lieutenantancy; £1800 for a captaincy; £3200 for a majority; and £4500 for a lieutenant-colonelcy, which was the highest rank that could be obtained by purchase. In theory an officer wishing to retire from the service might sell his commission for the price affixed to the rank he occupied. When a superior officer 'sold out', the next officer inferior to him might purchase promotion to the rank of the former by merely paying the difference between the prices of their respective commissions. The rank of the second might be reached in the same manner by his next inferior, and so on down to the ensign or cornet. No commission could be purchased by one officer unless another officer vacated his commission by its sale. The abolition of the purchase system took place in 1871, but the officers who were deprived of a saleable interest in their commissions were compensated by giving them a sum of money, the payment of which was to be extended over twenty-five years, and which, it was estimated, amounted to £8,000,000. Promotion has since been through seniority, tempered by selection. The Regimental Exchange Act of 1875 permitted the exchange of commissions through purchase under such conditions as the Crown might deem expedient for the time being.

Pur'gatives are drugs employed to evacuate the bowel of its contents. Many drugs produce this action, but have various other effects on the body tissues, and therefore are not included in this description; while the term purgative is used for those drugs that have little influence

beyond their action on the intestine. Many classifications of purgatives have been made, and such terms as laxative, cholagogue, and cathartic are still in use, but the action of a purgative is largely dependent on the dose and on the condition of the intestine. They are best grouped into the following four classes: (1) *mild purgatives*, including castor-oil, olive-oil, sulphur, glycerine, honey, figs, prunes, and many other fruits; (2) *anthracene purgatives* include rhubarb, senna, aloes, cascara, and are widely used in many different forms on account of their definite action; (3) *drastic purgatives*, whose action usually causes some griping and abdominal discomfort, are calomel, jalap, scammony, colocynth, elaterium, and croton-oil; (4) *saline purgatives* increase the amount of fluid in the intestine, and thereby give rise to easy evacuation. The chief of these are potassium tartrate and acid tartrate, potassium and sodium sulphate, and the sulphate and various other salts of magnesium.

Purgatory (L.Lat. *purgatorium*, from *purgare*, to cleanse), in theology, the place or condition of temporal punishment to which are submitted the souls of those who, though baptized, have departed this world without having attained perfection. It is the condition or place wherein these souls are being cleansed and purified by punishments for their sins before they are allowed to enter heaven. The punishments, however, may be mitigated and shortened by prayers offered for the dead and by the Mass. Catholic theologians base the doctrine of purgatory upon passages in the Holy Scriptures. Protestant theologians, however, maintain that all the texts adduced in favour of the doctrine can be interpreted differently, and they reject the doctrine, as it stands in direct contradiction with the teaching of salvation by faith, and is nowhere clearly taught in the Bible. The Roman Catholic Church, on the other hand, holds that death in itself is no sanctification, and the sinner who has failed to do penance in this life may be punished in another. Gregory the Great (604) was the first to lay the belief down as a dogma, and the Council of Trent defined it more clearly. The doctrine of purgatory is condemned by the Church of England in the 22nd Article.—**BIBLIOGRAPHY:** A. J. Mason, *Purgatory*; W. O. E. Oesterley, *The Doctrine of the Last Things Jewish and Christian*; H. C. Oxenham, *Catholic Eschatology and Universalism*.

Purification, The Jewish Rite of, was mainly one through the performance of which an Israelite was readmitted to the privileges of religious communion, lost through uncleanness. The chief varieties of such uncleanness, and the methods of purification from it required, are detailed in *Lev.* xii, xiv, xv, and *Num.* xix.

The necessity of purification was extended after the captivity to a variety of cases not included in the Mosaic legislation, such as the washing of cups and pots, &c., referred to in *Mark*, vii, 4.

Purification of the Virgin Mary, Feast of the, called also the Feast of the Presentation of the Child Jesus, is a festival of the Christian Church held on the 2nd of February, in commemoration of the event related in Luke's gospel, chapter ii. The festival dates from very early times, and is said to have been formally instituted by Pope Gelasius in A.D. 494. See *Candlemas*.

Purim, a Jewish festival observed on the 14th and 15th of Adar (March), instituted to commemorate the preservation of the Jews in Persia from the destruction threatened them by the schemes of Haman (*Esther*, ix).

Puritans, a name first applied to those English Protestants who regarded the Reformation in England as incomplete, and the Anglican Church, even of Edward VI, as retaining too much of the discipline, ritual, and ceremonial of the Church of Rome. Many of them who were driven into exile under Queen Mary, and who returned to England after the accession of Elizabeth, brought back a zealous desire to remodel the Church of England in the spirit of Continental Protestantism, especially that of Geneva. In 1572 a presbytery was set up at Wandsworth, in Surrey, and before many years Presbyterianism found adherents both among the clergy and the laity. Meanwhile the Brownists, the Independents of later days, whose Congregationalism was as much opposed to Presbyterianism as to Episcopacy, began to be organized and to make some progress. In doctrine these two Puritan parties differed little from each other, or from many Anglicans who remained contented with the Church of England as it was. During the later years of Elizabeth the nickname of Puritan was popularly bestowed on all in the Church, or out of it, whose views of religion led them to adopt a great austerity of life and gravity of demeanour; who made constant use of Biblical phraseology in their ordinary conversation, and who treated as sinful the most of the amusements and diversions of the society around them. The drama was specially obnoxious to them, and the dramatists repaid the hatred of the extreme Puritan by ridiculing and caricaturing him on the stage. Though the Puritans were always steadfastly loyal to Elizabeth, the legislation which she favoured visited with severe penalties Protestant nonconformity to the Established Church, and in 1592 several leading Brownists were brought to the scaffold. The hopes with which the accession of James I inspired the Puritan party in the Church were grievously disappointed when

their moderate demands for a reform of ritual and a slight modification of episcopal authority were rejected at the Hampton Court Conference. During his reign the prelates and many of the clergy became less Protestant, while the Puritan element in the Church, and out of it, increased in intensity. Nonconformity was pursued by new penal statutes, and numbers of Puritans emigrated to New England. This emigration continued during the reign of Charles I and the ascendancy of Laud. The Parliamentarians who took arms against Charles I were mainly Puritans, and the bulk of them were Presbyterians. Presbyterianism in England reached its height with the meeting of the General Assembly of Divines at Westminster. With the downfall of the Anglican system Independency again reared its head in England. The Independents now combined with their congregationalism the desire for a theological latitude, which widened the gulf between them and the Presbyterians. The army became leavened with Independency, and Oliver Cromwell its champion. With his ascendancy the influence of Presbyterianism as a power in the state dwindled, and Independency became the dominant element in English Puritanism. After the restoration of Charles II and of the old Anglicanism, the Presbyterians, Independents, and Baptists were the three chief denominations into which Puritanism had split up. Since then Nonconformists or Dissenters has been the term generally used where Puritans would formerly have been employed.—BIBLIOGRAPHY: H. O. Wakeman, *The Church and the Puritans*; J. Tulloch, *English Puritanism and its Leaders*; H. H. Henson, *Puritanism in England*; Stowel and Wilson, *History of the Puritans in England*.

Pur'nea, or **Purniah**, a district and town in the Bhagalpur division of Bihar and Orissa, India, originally belonging to Bengal. In the north it is conterminous with Nepál, and on the south it marches with the Ganges. It lies towards the eastern limit of the Gangetic Plain, and is generally flat. Rice, pulses, indigo, mustard, and tobacco are the chief products, rice being of most importance. The three towns are Purnea (the capital), Kishanganj, and Katihar (the railway junction). Area, 4998 sq. miles; pop. 2,000,000.—The town (Purnea) is on a railway feeder from Katihar, and was formerly a Mahommedan capital. It has declined on account of the silting up of the Kali Kosi River. Pop. about 15,000.

Purple, a secondary colour compounded by the union of the primaries *blue* and *red*. Of all the various kinds in use, the Tyrian dye was anciently the most celebrated. This colour was produced by the ancients from an animal juice found in a shell-fish called *murex*; and as it was

thus obtained only in small quantities, its use was restricted to the great and wealthy. It became the distinctive colour of imperialism, and the later emperors of the East forbade its use by subjects. Hence their offspring were called *porphyrogeniti*, born in the purple. In modern times, from the short purple mantle worn by them, cardinals are sometimes said to have obtained the purple. With the general disuse of the purple obtained from shell-fish, archil and cudbear, yielded by various species of lichens, were employed in the dyeing of silk and wool; but they have been superseded by the purples obtained from aniline. For cotton the chief purple dye was furnished by madder, but the alizarine to which madder owed its dyeing properties is now prepared from coal-tar. The common shades of purple with which wool is dyed are obtained from logwood with a mordant of alum and tartar.

Purple-emperor, the *Apatura* or *Nymphalis iris*, a large, somewhat rare, and richly coloured British butterfly; so called from the splendid purple iridescent colour of its fore wings.

Purple Heron (*Ardea purpurea*), an occasional visitor to Britain, of which the occipital plumes are glossy black tinged with purple.

Purples, **Ear Cockle**, or **Peppercorn**, a disease affecting the ears of wheat, produced by *Tylenchus tritici*, a species of thread-worm (see *Nematelmia*). The infected grains of wheat at first assume a dark-green colour, which soon deepens to a black, and become rounded like small peppercorns. The husks open, and the diseased grains are found to contain no flour, but a moist substance of white colour and of cottony consistence. A single grain of wheat may contain 50,000 embryos of *Tylenchus*. These fall to the ground with the grain, grow in the earth, and make their way to the young wheat, on which they mature. Dilute sulphuric acid, in the proportion of 1 part of acid to 100 parts of water, destroys the pest effectually.

Purple-wood, the heart-wood of *Copaifera pubiflora* and *C. bracteata*, a beautiful and durable kind of wood imported from Guiana, well adapted for buhl-work, marquetry, turnery, and other purposes.

Pur'pura, a genus of sea-snails, most of the members of which are littoral. Some of the species were among the molluscs that in ancient times furnished the celebrated dye known as Tyrian purple (chiefly obtained from a *murex*). The British species known as the dog whelk (*P. lapillus*) also yields a purple dye.

Purpura, or *the purples* (rarely used), is a condition in which spontaneous hæmorrhages occur in the skin and on mucous surfaces. These hæmorrhages may be either small spots, called petechiæ, or involve large areas, when the condition is

known as ecchymosis. Purpura may last over a long period, coming out in fresh crops, but often causing no discomfort. It may be primary or secondary. The primary form, frequently seen in children, varies from a mild attack, with little beyond slight diarrhoea and occasional joint pains, to severe hæmorrhages from the mucous surfaces of the gums and the intestine, with high temperature and possibly a fatal termination. In the secondary form the purpura is associated with some disease, and is seen in rheumatism, whooping-cough, kidney and liver diseases, and various septic conditions. Also it may occur in some forms of heart disease, various blood diseases, and in the debility due to cancer and tuberculosis.

Purse-crab, a name for decapod crustaceans of the genus *Birgus*, allied to the hermit-crabs. A species, *B. latro* (the robber-crab), found in the Mauritius and the more eastern islands of the Indian Ocean, is one of the largest crustaceans, being sometimes 2 to 3 feet in length. It lives on land, while paying a nightly visit to the sea, often burrowing under the roots of trees, lining its hole with the fibres of the coconut husk and living on the nuts, which (according to some writers) it climbs the trees to procure, and the shells of which it perforates with great ingenuity.

Pursuivant, an attendant on the heralds, one of the third and lowest order of heraldic officers. There are four pursuivants belonging to the English College of Arms, *Rouge Croix*, *Blue Mantle*, *Rouge Dragon*, and *Portcullis*. In the court of the Lyon King-of-Arms in Scotland there were formerly six pursuivants, *Unicorn*, *Carrick*, *Bute*, *Kintyre*, *Ormond*, and *Dingwall*, but the last three have been abolished.

Purus, a river of South America, rising in the east of Peru, traversing Bolivia, and entering Brazil, where it joins the Amazon through a large delta 120 miles above Manáos and 100 miles above the confluence of the Amazon and Madeira. Length, 1800 miles, navigable for about 1600 miles.

Purveyance, formerly in England the exercise by officials called *purveyors* of the royal prerogative, involving a right of pre-emption, by which the king was authorized to buy provisions and necessaries for the use of his household at an appraised value, in preference to all his subjects, and even without the consent of the owner; it included the right of impressing horses and carriages, &c., for the use of the sovereign. It was also practised by many of the great English nobles. It led to much oppression and many exactions, was dealt with in the Magna Charta, and a number of statutes were passed to prevent the grievance. It was abolished in 1660.

Pus is the fluid product of suppuration, due to bacterial action, and is a thick creamy substance containing dead white blood-corpuscles with fragments of cells, fibrous tissue, organic debris, and bacteria. It is found in abscesses and wherever suppuration has occurred.

Pu'sey, Edward Bouverie, English divine, was born in 1800, and died in 1882. He was educated at Eton and Christ Church, Oxford, and became Fellow of Oriel in 1824. In 1828 he was appointed to the regius professorship of Hebrew at Oxford, to which was attached a canonry of Christ Church. In 1833 the *Tracts for the Times* began to appear, but he was not prominently connected with the Tractarian movement until 1835-6, when he contributed to the *Tracts* one on baptism, which excited much attention. He published a defence of the famous *Tract No. 90*, and in 1843 he was suspended by the vice-chancellor of Oxford from preaching for three years, on account of the very high sacramental doctrine inculcated in his sermon on the Eucharist, preached before the university. The prominence thus given to him, his position in the university, his reputation for scholarship, and his thoroughgoing advocacy of 'Anglo-Catholic' principles, procured the general adoption of the term Puseyism as a synonym of Tractarianism; and with the secession of Newman to Rome, Pusey became the acknowledged head of the new Church party. Among the more substantial of his works, in addition to his *Library of English Fathers* and *Anglo-Catholic Library*, are his *Councils of the Church*, from the Council of Jerusalem, A.D. 51, to the Council of Constantinople, A.D. 381 (1857); *Daniel the Prophet*, nine lectures (1864); and the *Minor Prophets*, with a commentary and introduction to the several books (1860-77).—BIBLIOGRAPHY: B. W. Savile, *Dr. Pusey: an Historic Sketch, with some Account of the Oxford Movement*; H. P. Liddon, *Life of Edward Bouverie Pusey*.

Pushkin, Alexander Sergéyevitch, Russian poet, born at St. Petersburg (Petrograd), 1799, died 1837. At an early age, on account of his liberal opinions, he was sent to Odessa, where he discharged various offices, but was restored to favour on the accession of Nicholas I in 1825, who appointed him imperial historiographer. He made a study of foreign literatures, and was much influenced by Byron. His first poem was *Ruslan and Liudmila* (1821); this was followed by *The Prisoner of the Caucasus*, *The Foundation of Bakhtchisarai*, *Eugene Onegin*, *The Gypsies*, and *Poltava*. He was also the author of a dramatic poem, *Boris Godounov*. He fell in a duel with his brother-in-law.

Pushtu, or **Pashtu**, the vernacular language of the Afghans, regarded as an Aryan language, more or less allied to the Iranian group, from

which, however, it is totally different in construction and in idiom. Persian is the language of the educated classes in Afghanistan, and is also known to the people, who, however, prefer the use of Pushtu.

Pustule is a small papule containing pus. It is an inflamed elevated mass under the skin, and is painful and tender to the touch. In certain septic infections pustules appear, and they are present in smallpox and chickenpox. *Malignant pustule* is the name given to a form of local infection by anthrax, seen in human subjects who work with anthrax-infected carcasses.

Putchock, or **Puchuck**, the root of *Aplotaxis* (*Saussurea*) *Lappa*, a composite plant growing on the Himalaya in the vicinity of Kashmir. It is exported to the Malay countries and to China, where it forms a main ingredient in the Chinese pastille-rods known as *joss-sticks*. In Upper India it is given as a medicine in various complaints ranging from coughs to cholera.

Puteaux (pù-tô), a town of France, in the department of the Seine, on the left bank of the Seine, a short distance west of Paris. Its industries include calico-printing, tanning, dyeing, and the manufacture of chemicals and mineral-waters. It is a suburb of Paris. Pop. 32,000.

Putney, a suburb of London, in the county of Surrey, on the right bank of the Thames opposite Fulham, and within the Metropolitan borough; served by the London & South-Western Railway, and by motor-bus, tram, and District Railway. The head-quarters of the rowing world is at Putney, which is also the starting-point of the Inter-Varsity boat-race. Putney bridge was erected in 1886 to replace a wooden one of date 1729. Pop. (1921), 28,240.

Putney was called *Putelei* at the time of the Domesday Survey, and the Heath was a favourite meeting-ground for the settlement of differences with the sword.

Putomayo, a territory and river of Colombia, South America. The territory is conterminous with Ecuador, with which country and with Peru there have been boundary disputes. The capital is Mocoa. Area indefinite; pop. (1918), 40,770 (33,000 being Indians). The Putomayo or Ipo River traverses the territory, rising near Pasto (Colombia), and joining the Amazon near São Antonio. It is navigable by river-steamers for upwards of 700 miles.

'Putomayo Atrocities' was a term applied to a series of offences committed by the Peruvian Amazon Company (British) during 1909. As the outcome of emphatic allegations made in 1909 by a British writer, the British Government ordered Roger Casement (afterwards executed for treason) to investigate, and his report (Cd. 6266/of 1912) substantiated the rumoured existence of atrocities of a most revolting kind,

by which the Peruvian Amazon Company forced their native labourers in the rubber plantations to work. At the joint representation of the British and United States Governments, some of the worst offenders were punished by the Peruvian authorities.

Putrefaction, the name given to the decomposition of organic matter (proteins), whether of plant or animal origin. Putrefaction usually begins after the death of the organism, and is accompanied by the evolution of gases, many of them of a fetid nature. It is due to the agency of bacteria. These minute organisms are present in vast numbers in the air, and settle on the organic matter, in which they find a suitable medium for development and growth. This growth is accompanied by the formation of ferments (enzymes), which cause a splitting-up or decomposition of the complex compounds present in the organic material. The products thus formed are of a comparatively simple nature—many are gaseous, e.g. hydrogen, nitrogen, ammonia, carbon dioxide, hydrocarbons, &c., and sometimes compounds of sulphur and phosphorus. In many cases the products formed in putrefaction are the same as the products obtained by the action of dilute acid on proteins; among these may be mentioned organic bases, such as methylamine and the poisonous ptomaines, amino-acids, and other acids, e.g. oxalic and lactic acids. The rate of putrefaction and the nature of the products are affected by temperature, moisture, and access of air. Putrefaction can be prevented by exposure to a high or very low temperature, by the withdrawal of moisture, or by the addition of different kinds of antiseptics, such as formaldehyde, borax, salicylic acid, &c. All these methods destroy the activity of the organisms that give rise to putrefaction, and are employed on the large scale for preserving food-stuffs. Putrefaction is prevented by *sterilization*, i.e. exposure to a high temperature, so that all bacteria present are destroyed; and afterwards preventing the access of others. A special bacillus (*B. botulinus*) is sometimes associated with the forms causing putrefaction, and the virulently poisonous substance formed by its activity is not destroyed by preservation methods. See *Botulism*; *Preserved Foods*.

Puttenham, George, English writer, regarded as the author of *The Art of Poesie*, a work of ability, which appeared anonymously in 1589. If its author, he was, from indications given in that and another work from the same pen, born about 1530, and became a scholar of Oxford. In 1579 he presented a series of poems called *Partheniades* to Queen Elizabeth. *The Art of Poesie* is a review of ancient as well as modern poetry, and was written for the court

and to instruct in versification. The book is also attributed to Richard, brother of George Puttenham.

Putty, a kind of paste or cement compounded of whiting or carbonate of lime and linseed-oil, beaten or kneaded to the consistence of dough. In this state it is used by glaziers for fixing in the squares of glass in window-frames, &c., and also by house-painters to stop up holes and cavities in wood-work before painting.

Putty-powder, a pulverized oxide of tin sometimes mixed with oxide of lead. It is extensively used for polishing and other purposes in glass- and marble-works; the best kinds are used for polishing plate.

Puy (pû-ê), Le, called also *Le Puy-en-Velay*, and *Le Puy-Notre-Dame*, a town of France, capital of the department of Haute-Loire. Overlooking the town is a conical rock crowned by a small chapel and a colossal statue of the Virgin. There is an ancient cathedral. The manufactures are chiefly lacc, leather, spirits, and woollens. Pop. 20,000.

Puy-de-Dôme (pû-ê-dê-dôm), a department of Central France, comprising parts of the pre-Revolutionary provinces of Bourbonnais, Auvergne, and Lyonnais; area, 3090 sq. miles; takes its name from a volcanic cone (4805 feet) which overlooks it. The highest point in the department, Puy-de-Sancy (6188 feet), is the most elevated peak of Central France. The department, with its numerous extinct volcanoes, is rich in granite, lead, and oil. The principal rivers are the Allier, Cher, Dordogne, and Dore. There are coal and other mines in the department, which also contains a number of springs, visited by invalids since the days of the Romans. The manufactures include cottons and woollens, paper, leather, &c. The capital is Clermont-Ferrand. Pop. (1921), 490,560.

Pwllheli (pul-hă'lê), a municipal borough and seaport of Wales, in Carnarvonshire, on Cardigan Bay; served by the Cambrian Railway. It is an old town, is surrounded by splendid scenery, is much visited by tourists, and is a favourite watering-place. It belongs to the Carnarvon district of parliamentary boroughs. Pop. (1921), 3811.

Pyæmia is a condition of infection of the blood by organisms or their toxins (*septicæmia*), which results in the formation of abscesses in different parts of the body. The bacteria are first present in some local focus of infection, most generally in the skin or subcutaneous tissues, and from these they or their toxins are carried throughout the body by the bloodstream. The abscesses vary in situation, according to the original site of infection and to the type of organism. They may be found in the

lungs, kidneys, spleen, brain, joints, and in muscles, and any region which is injured is specially susceptible on account of the damage to the tissues. High fever is present, with abrupt rises and falls of temperature; rigors are frequent, accompanied by drenching sweats. The prognosis in all cases is grave and the mortality high.

Pycnog'onum, the type-genus of an aberrant class of marine Arthropoda, the Pycnogonida, or the sea-spiders. Some species are parasitic on other marine animals, but the common British species, *P. littorale*, is free when adult, and does not appear to be parasitic during any period of its existence. The largest member of the class is a deep-sea Pycnogon from the Antarctic (*Colossendeis gigas*), which is 2 feet across, and of a deep orange-scarlet colour.

Pye, Henry James, Poet Laureate and poetaster, born in 1745 of an old Berkshire family, died in 1813. Educated at Magdalen College, Oxford, he entered Parliament as member for Bucks in 1784. Having in 1775 published a translation of six odes of Pindar, in 1778 one of Frederick the Great's *Art of War*, and in 1786 another of the *Poetics* of Aristotle, with a commentary, he was, in 1790, appointed Poet Laureate in succession to Warton. The appointment, which was a reward for his loyalty to Pitt, was ridiculed by the public. In 1792 Pye was appointed a Westminster police magistrate. In 1801 appeared his *Alfred*, an elaborate but ineffectually tedious epic.

Pygma'liion, in Greek mythology, a king of Cyprus, who, disgusted with the debaucheries of his countrywomen, took an aversion to the sex. According to Ovid (*Met.* x, 243) he made an ivory image of a maiden, fell in love with his own work, and entreated Venus to endow it with life. His prayer was granted, and the maiden became his wife. W. S. Gilbert's drama of *Pygmalion and Galatea* is founded on this story.

Pygmies are populations of very small men of negroid type, whose average height falls below 1.5 metres (4 feet 11 inches). Individuals of almost any race may be as short as pygmies, but such dwarfs must be clearly distinguished from true pygmies, in which a whole people alike share the diminutive stature. Pygmy peoples are found chiefly in Africa and in the islands near the south-eastern part of the Asiatic area. In tropical Africa the pygmy negroes or negrilloes, as they are termed, are widely distributed, and were known to the ancient Egyptians and the Greek historians. Farther south are found the Bushmen and Hottentots, who also belong to the pygmy peoples. The true Asiatic pygmies or negritoës reveal in their size and physical structure, especially the characteristic so-called woolly hair and black skin, evidence

of close kinship to the *negrilloes* of equatorial Africa. They are found in the Andaman Islands, the Malay Peninsula, the Philippines, and New Guinea. In the Malay Peninsula they are known as the Semang and in the Philippines as the Aeta.

The chief scientific interest in these *negrito* and *negrillo* peoples is the demonstration they afford of the fact that some of these pygmy negroes must have traversed the whole southern littoral of Asia from the original home of the race, wherever that was. There is some evidence that *negritos* also accompanied the taller negroes in their wandering still farther east to Melanesia. The true pygmies or *negritos* must be clearly distinguished from other small black people belonging to a distinct and much more primitive race, akin to the aboriginal Australians. The height of these people, however, slightly exceeds the limit of the pygmy peoples. The Sakai and Senoi of the southern part of the Malay Peninsula are typical examples of these small Australoid peoples; others are found in East Sumatra and in Celebes (Toala); but kindred peoples are found in Ceylon (Veddas), among some of the jungle tribes of the Indian Deccan (pre-Dravidians), in Australia, and probably also in New Guinea.

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Py'lades (-déz), in Greek mythology, son of Strophius, King of Phocis, and Anaxibia, the sister of Agamemnon, after whose murder by Clytemnestra, their son Orestes, being carried secretly to the court of Strophius, formed the friendship with Pylades which has become proverbial. He assisted Orestes in murdering Clytemnestra, and eventually married his sister Electra.

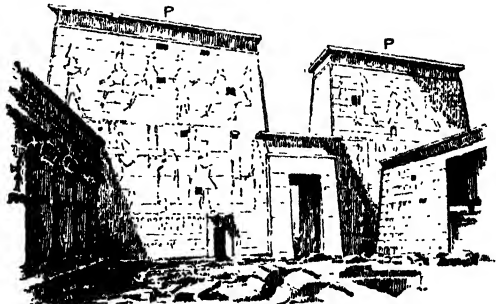
Pylons, in Egyptian architecture, the name given to towers or masses of masonry, somewhat resembling truncated pyramids, placed one on each side at the entrance of temples, and having a very imposing appearance. Behind them in the larger temples there was often a large open court, and in front there might be an avenue with sphinxes on either side. An entrance of which these pylons form part is sometimes called a *propylon*.

Pylo'rus is the region at the right end of the

stomach where it joins the intestine. It is composed of a ring of circular muscle fibres which control its opening and closing, and their action is influenced by the stomach contents, so that normally the food-stuff only passes onwards into the intestine when a suitable stage of digestion has been reached.

Pylos, a town of ancient Greece memorable in the Peloponnesian War, and represented by the modern Navarino.

Pym, John, English statesman and leader of the popular party during the reigns of James I and Charles I, born in Somersetshire 1584, died in 1643. He studied at Oxford, became famous as a lawyer, and entered Parliament in 1614. During the reign of James he attained great influence by his opposition to the arbitrary measures of the king. He sat for Tavistock in all the Parliaments of Charles's reign. In 1626 he took part in the impeachment of Buckingham and was imprisoned. In the Short Parliament of 1640 Pym and Hampden were exceedingly active as leaders of the popular party, and in 1641 Pym was offered the chancellorship of the exchequer. He impeached Strafford, and at his trial appeared as accuser. He was the main author of the Grand Remonstrance, the final appeal presented in 1641, and one of the five members to arrest whom the king went to the House of Commons in Jan., 1642. When civil war became inevitable, Pym was appointed one of the committee of safety, and while he lived was active in resisting the negotiation of any peace with the king which did not secure the liberties of the subject and the supremacy of Parliament. It was mainly his financial skill that enabled the Parliamentary army to keep the field. In Nov., 1643, he was made Lieutenant-General of Ordnance, and in the following month he died, and was buried in Westminster Abbey.



Entrance Court, Temple at Philæ, showing Pylons, P, P.

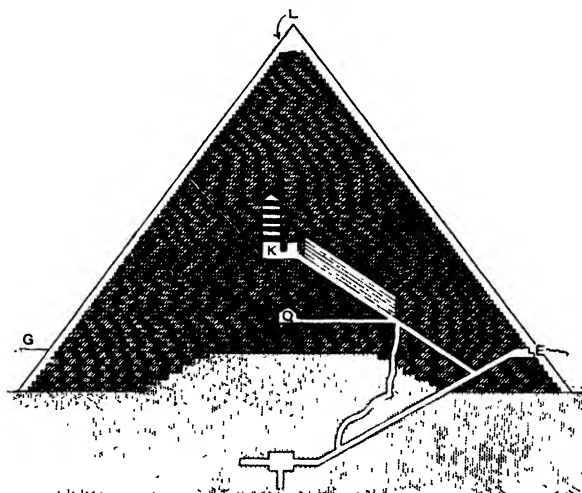
His body was ejected thence after the Restoration.

Pyr'amid, in geometry, is strictly a solid contained by a plane triangular, square, or

polygonal base, and other planes meeting in a point. This point is called the vertex of the pyramid; and the planes which meet in the vertex are called the sides, which are necessarily all triangles, having for their bases the sides of the base of the pyramid. The volume of a pyramid is one-third the volume of a prism that has the same base and altitude as the pyramid. Pyramids are denominated triangular, square, pentagonal, &c., according as the base is a triangle, a square, a pentagon, &c.

Pyramid, in architecture, a colossal structure of masonry having a rectangular base and four triangular sides terminating in a point, used by the ancients in various parts of the world for sepulchres or for religious purposes, especially in Egypt. The largest and most remarkable of the Egyptian pyramids occur in several groups on the west side of the Nile, on the border of the Libyan Desert, extending for a distance of about 25 miles from north to south, the farthest north being opposite Cairo. They are built chiefly of the hard limestone of the adjacent hills, but large blocks of granite brought from a distance are also used, especially on the outside. The four sides are so placed as to face the four cardinal points. These structures are supposed to date from about 3000 B.C. to 2300 B.C. The stones used varied in size, but are mostly large, requiring wonderful mechanical skill to quarry them, transport them, and raise and adjust them in their proper places. Labourers in almost fabulous numbers were engaged in erecting the chief Egyptian pyramids, of which the group of Gizeh, 4 miles s.w. of Cairo, in the neighbourhood of the ancient Memphis, is the most remarkable. This group consists of nine pyramids, among them the three most celebrated of all, the pyramid of Cheops (Khufu), called the Great Pyramid; of Cephren (Khafra); and of Mycerinus (Menkauru). According to Herodotus, the Great Pyramid took 100,000 men working for ten years to make a causeway 3000 feet long in order to facilitate the transport of the stone from the quarries; and the same number of men for twenty years more to complete the pyramid itself. Its base forms a square, each side of which was originally 768 feet, though now, by the removal of the coating, only 750 feet long, occupying 13 acres. The outer surface forms a series of steps, each of the average height of 3 feet or more. When the structure was perfect, this step formation was hidden by the coating, which rendered the sides quite smooth, and the

apex, where there is now a space of 12 sq. yards, was no doubt originally quite sharp. The height was originally about 480 feet, but is now only 451 feet. The interior, entered 49 feet above the base of the north face, contains several chambers, one of which, called the King's Chamber, is 34½ feet long, 17 feet wide, and 19 feet high, and contains a sarcophagus of red granite. The second pyramid is 690 feet square and 447 feet high. The third pyramid is only 354 feet square and 203 feet high, and is the best constructed of the three. The six smaller pyramids which complete the Gizeh group are of much inferior interest. The pyramids are supposed to have been built by the



The Great Pyramid of Cheops (in section)

K, King's chamber. Q, Queen's chamber. E, Entrance. G, Ground.
L, Original casing of limestone.

respective kings as tombs and memorials of themselves: and it is conjectured that they were begun at the beginning of each reign, and that their size corresponded with the length of it. About 350 yards south-west of the Great Pyramid is the celebrated Sphinx. Ruins of pyramids are to be found at Benares in India and in other parts of the East. Certain monuments of the ancient inhabitants, found in Mexico, are also called pyramids. These seem to have been intended to serve as temples, the tops of them being flat and surmounted by a house or chamber in which sacred rites were probably performed. The largest and perhaps the oldest of them is that of Cholula, which is said to have a base of 1770 feet and a height of 177 feet.—BIBLIOGRAPHY: W. M. F. Petrie, *Gizeh and Rifeh*; Sir E. A. Wallis Budge, *The Nile*; A. B. Gosse, *The Magic of the Pyramids and the Mystery of the Sphinx*.

Pyramids. See *Billiards*.

Pyramus and Thisbe, a pair of devoted lovers, who, as their story is told by Ovid (*Met.* iv, 55-165), resided in Babylon, and being prevented by their parents from meeting openly, were in the habit of secretly conversing through an opening of the wall, as their houses adjoined. They agreed one day to meet at the tomb of Ninus, when Thisbe, who was the first at the rendezvous, was surprised by a lioness and took to flight. In her haste she dropped her garment, which the lioness seizing covered with blood, having immediately before killed an ox. Pyramus appearing on the scene, and concluding from the blood-besmeared robe that Thisbe was dead, killed himself. Thisbe returning soon afterwards, and finding the body of her lover, also killed herself. The story was very popular in the time of Shakespeare, who made it the subject of the burlesque interlude in *A Midsummer Night's Dream*.

Pyrargyrite, a handsome purple-red ore of silver ('dark-red silver ore', in opposition to the light-red *proustite*, which contains arsenic in place of antimony). Pyrargyrite is a silver antimonide and sulphide, Ag_3SbS_3 , and is often an important ore.

Pyrenees, a mountain range, part of the Alpine system of Europe, the crest of the main chain of which forms the boundary between France and Spain. They abut with one extremity on the Mediterranean, and with the other on the Atlantic, their western extension, the Cantabrian Mountains, fringing the southern shores of the Bay of Biscay for a considerable distance. They consist of two lines, which form parallel ridges about 20 miles apart from each other, except near the centre, towards which the range rises from both east and west, and the descent on the south side is much more abrupt than on the north. The loftiest summits are near the centre; the culminating point, Pic de Néthou in the Maladetta, reaches a height of 11,424 feet. The principal passes in the Pyrenees, formed by the meeting of valleys from opposite sides of the axis, take in the east part of the chain the name of Cols, and towards the centre that of Ports. Only four of these are conveniently practicable. See *Spain* for trans-Pyrenean railways and communications.

Pyrénées (Basses-), a south-western frontier department of France, with a seaboard of 17 miles on the Bay of Biscay, between the Bidassoa and the Adour. Along the ridge of the Pyrénées, which rises from west to east, the department forms the boundary with Spain, and within the department are the Pic du Midi d'Ossau (9465 feet altitude) and the Pic du Palais (9760 feet altitude). The famous Pass of Roncevaux and some twenty-six others (mostly fortified) permit communication with Spain. Pau (a noted

health-resort) is the capital; other towns are Biarritz (watering-place) and Oloron. Viticulture is followed, cattle and horses are bred, and agriculture flourishes; there are several mineral-springs; fish is abundant in the streams, and the mountains are more or less afforested; copper and stone are found.

Basses-Pyrénées has about the same territorial dimensions as the pre-Revolutionary province of Béarn, but the south-west is Pays Basque. The Basques and Béarnais have retained many old customs and much of their mediæval simplicity of life, especially in the more mountainous districts. Area, 2977 sq. miles; pop. (1921), 402,980 (or 135.4 per square mile). In 1911 the population was 433,320.

Pyrénées (Hautes-), a southern frontier department of France, embracing in the south a large area of the Central Pyrenees, which forms the boundary-divide with Spain. In the north cereals and fruit are produced and viticulture is progressive. Tarbes is the capital; other towns are Luz, Vic, Lannemczon, and Lourdes. Area, 1750 sq. miles; pop. 185,760 (or 106.1 per square mile).

Pyrénées - Orientales, a department of Southern France (part of the pre-Revolutionary provinces of Roussillon and Languedoc), bordering on the Mediterranean and the Spanish frontier, and drained by the Aude, Ariège, Tech, Tet, and Agly. The culminating peak is Mont Canigou (9100 feet). There are numerous lakes. Its chief wealth lies in its wines, of which the well-known Roussillon is one. The department is very rich in iron and copper; lead and granite are also found. Perpignan is the capital. Area, 1598 sq. miles; pop. (1921), 217,503.

Pyrenees, Peace of the, concluded between France and Spain by Cardinal Mazarin and De Haro, on the 11e des Faisans, in the River Bidassoa, on the borders of the two countries, 7th Nov., 1659, terminated a war which had lasted for twenty-four years. By this treaty Spain ceded to France Roussillon, with the fortress of Perpignan, &c., so that the Pyrenees have since formed the boundary of the two kingdoms; and in the Netherlands, Artois, and part of Flanders, Hainault, and Luxemburg, with a number of fortified towns.

Pyrenomyces, one of the main subdivisions of Ascomycetous Fungi, distinguished by the ascus-fruit, which is a flask-shaped structure, opening when ripe by a narrow pore at the tip, and termed a *perithecium*. The further classification of this large and important group is based chiefly on the detailed structure of the perithecium; the leading families are the Hypocreales (including Claviceps, Cordyceps, Nectria), in which the perithecium is fleshy or waxy and

highly coloured, and the Sphæriales (including *Leptosphaeria* and *Xylaria*), in which it is hard and black.

Pyreth'rum, a genus of herbaceous plants nearly allied to *Chrysanthemum*. *P. Parthenium* is known as feverfew; from *P. roseum* is made the well-known Persian insect-powder.

Pyrgos, a town of Greece, near the west coast of the Morea, and not far from the mouth of the Ruphia (Alpheios). Its harbour is at Katakolo, with which and with Athens there is railway communication, and it carries on a large trade in grapes, currants, and oranges. Pop. (1920), 13,246.

Pyrhe'liometer, or **Pyrohellometer**, an instrument devised by Pouillet for measuring the intensity of the heat received from the sun. It consists of a shallow cylindrical vessel of thin silver or copper metal, containing water or mercury in which the bulb of a thermometer is plunged. The upper surface of the vessel is covered with lamp-black, so as to make it absorb as much heat as possible, and the vessel is attached to a support in such a way that the upper surface can be always made to receive the rays of the sun perpendicularly. The actual amount of heat absorbed by the instrument is calculated by ordinary calorimetric means. The area of the exposed blackened surface and the mass of water or mercury which has been raised through a certain number of degrees being both of them known, the absolute heating effect of the sun, acting upon a given area under the conditions of the experiment, can be found. Estimates of the sun's temperature from the indications of this instrument varied widely, and other methods, such as that of the optical pyrometer, are now used for this purpose.

Pyrites (pi-ri'tēz), a name given in mineralogy to various metallic sulphides, chiefly to the sulphides of copper and iron. For iron pyrites (pyrite), see *Iron*. See *Marcasite*; *Chalcopyrite*.

Pyro-electricity, a name given to the electrification which appears on certain minerals and organic substances when these are heated or cooled. The effect was first discovered in tourmaline. If a crystal of tourmaline is hung up by a silk thread in a heating-chamber, one end of the crystal becomes positively and the other end negatively electrified. This polarity continues while the temperature rises, but reverses as the temperature falls, and the effect is observed only within the limits 10° to 150° C. It appears to be associated with a difference in the crystalline structure of the two ends of the crystal. The property is also exhibited by boracite, quartz, cane-sugar, and sulphate of quinine.

Pyrogallic Acid, ($C_6H_6O_3$), or more correctly *pyrogallol*, a substance belonging to the class of

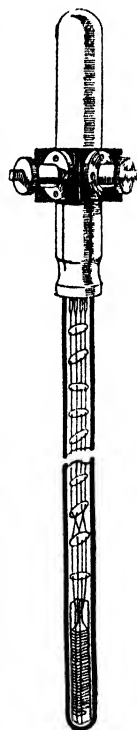
bodies known as phenols, and obtained by the dry distillation of gallic acid. It forms colourless, odourless crystals, and is readily soluble in water, alcohol, and ether. Its alkaline solution readily absorbs oxygen, turns deep brown, and is used in gas analysis. It is also used as a developer in photography.

Pyrolig'neous Acid, an aqueous solution obtained in the dry distillation of wood. It consists chiefly of acetic acid, but also contains methyl alcohol, acetone, homologues of acetic acid, and empyreumatic products (see *Empyreuma*).

Pyrol'usite, a mineral consisting of manganese peroxide, MnO_2 , in the form of black crystalline masses. It is soft and even soils the fingers, while a rare hard mineral form of MnO_2 , *polianite*, exists, which crystallizes in the tetragonal system. Pyrolusite is orthorhombic, and the similarity of its crystals to those of manganese make it probable that they are pseudomorphs after that mineral. It occurs in Devonshire, Warwickshire, Brazil, &c., and is much used in chemical processes, for example, the preparation of chlorine.

Pyrom'eter, an instrument for measuring high temperatures. Many of the physical actions of heat upon metals are made use of in these devices. Under the influence of change of temperature the electrical resistance of a metallic wire changes, and pyrometers working on this principle were devised by Professor Hugh L. Callendar, who made his thermometers with platinum wire. The resistance is usually measured with a Wheatstone's bridge testing-set — such as that of Whipple — with the wire graduated in degrees of temperature. As the wires leading to the platinum coils are also subject to rise in temperature and consequent alteration in electrical resistance, a similar pair of wires or compensating leads is connected to the other side of the Wheatstone's bridge; the observations are thus those due to the change of resistance of the platinum wire only. The platinum coil is wound on a mica frame, and the connecting wires are passed through holes in small mica washers, which keep them in place within the containing glass, porcelain, or silica tube.

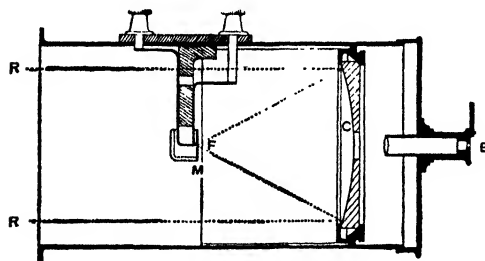
When dissimilar metals are heated in contact



Platinum Thermometer

with one another, an electromotive force is produced which has a magnitude depending upon the temperature. Thermo-electric pyrometers with thermo-couples of platinum in contact with alloys of platinum and rhodium or iridium, nickel with an alloy of nickel and chromium, iron and nickel (constantan), and copper with constantan are in common use. The thermo-couple pyrometer measures the difference of temperature between the hot junction and the other end of the two pieces of metal. If the cold junction is always kept at the same standard temperature, the actual temperature of the hot junction can be obtained by adding the reading of the instrument to the temperature of the cold junction. In commercial instruments it is common to use leads of the same materials as the thermo-couple; the cold junction can then be placed at the indicator, where there is greater possibility of maintaining constant temperature conditions.

It is a great advantage if the pyrometer is not subjected to the temperature which is to be measured. The radiation pyrometer is of great value in measuring furnace temperatures. One of the most commonly used instruments is



Féry Pyrometer

E, Eyepiece. C, Concave mirror. F, Focus of mirror. M, Thermo-couple receiver. R, R, Heat rays from furnace.

that of Féry, in which the heat rays from the furnace are received on a concave mirror and reflected on to a thermo-couple, and the temperature is then read from the scale of a galvanometer. A very ingenious device is used to ensure that the rays are all focused on the couple.

Pyromor'phite, a yellow or greenish (rarely purplish) mineral, orthophosphate of lead, with chlorine; its molecular and crystalline structure agree with that of apatite. Its formula may be written $(\text{PbCl})\text{Pb}_4(\text{PO}_4)_3$, or $3\text{Pb}_3\text{P}_2\text{O}_8 \cdot \text{PbCl}_2$.

Py'rope, fire-garnet or Bohemian garnet, a dark-red variety of garnet, found especially in the mountains of Bohemia. It occurs also in Saxony in serpentine. See *Garnet*.

Pyro'sis, or **Water-brash**, is a condition due to defective digestion in the stomach, resulting in a burning pain being felt in that region, accompanied by eructations.

Pyroso'ma, a genus of phosphorescent Tunicata, compound ascidians inhabiting the Mediterranean and Atlantic. Each colony consists of a great number of individuals, embedded in a firm transparent matrix, and forming a large hollow cylinder, open at one end and closed at the other, swimming in the ocean by ejection of a current of water from the open end of the cylinder.

Pyr'oxenes, an important group of mineral silicates, including *augite* (q.v.), occurring in igneous and metamorphic rocks.

Pyrrox'yline, a name applied somewhat loosely to gun-cotton, and other products of the action of nitric acid on cellulose (q.v.). When cotton is soaked in a mixture of nitric and sulphuric acids, a series of cellulose nitrates is produced, in proportions depending largely on the concentration of the acid mixture, and on the temperature. The highest and most explosive member of the series is gun-cotton or cellulose hexanitrate, $\text{C}_{12}\text{H}_{14}(\text{ONO}_2)_6\text{O}_6$; this is insoluble in a mixture of alcohol and ether. 'Soluble gun-cotton', used in the preparation of collodion, celluloid, and artificial silk, is a mixture of lower nitrates of cellulose. These are distinguished from the hexanitrate by their solubility in ether-alcohol. In pharmacy, the name pyroxyline, or pyroxylin, is restricted to the tetranitrate $\text{C}_{12}\text{H}_{16}(\text{ONO}_2)_4\text{O}_6$.

Pyrrhic Dance, an ancient Grecian warlike dance. It was danced to the sound of the flute. We learn from Plato that its aim was to represent an attempt to avoid the blows of an enemy in battle. The motions necessary to perform the dance were looked upon as a kind of training for war. In the non-Doric states the dance was purely mimetic, and frequently performed by women. It was introduced into the Roman public games by Julius Caesar, and was danced by male and female dancers, having a somewhat dramatic character. A dance called Romaika, existing in the mountainous districts of Thessaly and Macedonia, and performed by men armed with muskets and swords, is supposed to be a modern survival of the Pyrrhic dance.

Pyrrho, Greek philosopher of Elis, founder of the Pyrrhonian or sceptical school, flourished about 340 B.C. He was early led to apply himself to philosophy by the writings of Democritus, and, accompanying his master, Anaxarchus, to India, in the train of Alexander the Great, he there became acquainted with the doctrines of the Brahmans, Magi, and other Eastern philosophers. Spending a great part of his life in solitude, and abstaining from all decided opinions concerning moral and physical phenomena, he endeavoured to attain a state of tranquillity not to be affected by fear, joy, or sorrow. He died in his ninetieth year; the Athenians erected a statue in honour of him, and his countrymen,

who had made him a high-priest, raised a monument to his memory. Led by his temperament and his manner of life to esteem an uninterrupted tranquillity the great object of philosophy, believing that nothing tended so much to destroy this quiet as the interminable disputes of the schools of the Dogmatists, he determined to seek elsewhere the peace which he despaired of finding in dogmatic philosophy. This led him to scepticism. His chief doctrines were the uncertainty of all human knowledge, and the belief that virtue is the only good. Pyrrho left no writings. It is only from the works of his later followers, particularly Sextus Empiricus, that we learn the principles of his school. A disposition to doubt is often called, from this philosopher, *Pyrrhonism*. See *Scepticism*.

Pyrrhotine, a bronze-coloured mineral often styled *magnetic pyrites*, composed of ferrous sulphide, FeS, with some additional absorbed sulphur. It is important on account of its common association with ores of nickel, as at Sudbury, in Ontario. Its powder is attracted by a bar-magnet.

Pyrrhus, King of Epirus, was born about 318 B.C., and was left an orphan in childhood. He was placed on the throne of his ancestors when about twelve years of age, and reigned peacefully five years, when advantage was taken of his absence to transfer the crown to his great-uncle, Neoptolemus. After serving with his brother-in-law Demetrius Poliorcetes, and greatly distinguishing himself at the battle of Ipsus, against Antigonus, 301 B.C., Pyrrhus recovered his dominions, which he shared with his rival, and then caused the latter to be put to death. He next contended for possession of Macedonia, and in 280 passed over into Italy to assist the Greeks against Rome. He defeated the Romans in two battles, but with severe loss to himself; then passed over into Sicily, returned to Italy again, and was defeated at Beneventum, 275 B.C. He then retired to Epirus, took part in the Greek troubles, and was killed at Argos, 272 B.C.

Pyrus, a genus of ornamental and fruit trees, the latter forming the chief of our orchard fruit, and belonging to the pomaceous section of the nat. ord. Rosaceæ. There are about forty species, natives of the north temperate and cold regions. The pear (*P. communis*), the apple or crab (*P. malus*), service tree (*P. torminālis* and *domestica*), mountain-ash or rowan tree (*P. aucuparia*), beam tree (*P. aria*), &c., all belong to this genus.

Pythag'oras, Greek philosopher, supposed to have been born at Samos about 582 B.C. He went to Seyros, and was a scholar of Pherecydes till the death of the latter; others make him also a scholar of Thales and Anaximander. He is said to have gathered knowledge from the philoso-

phers or learned men of Phœnicia, Syria, Egypt, Babylon, India, &c., but eventually settled at the Greek city of Crotona, in Lower Italy, probably about 529 B.C. His abilities and character led great numbers, chiefly of the noble and wealthy classes, to adopt his views. Three hundred of these were formed into a select fraternity or order, and were bound by vow to Pythagoras and each other, for the purpose of cultivating the rites and observances enjoined by their master, and studying his philosophy. They thus formed at once a philosophical school and a religious order. The political influence of this body became very considerable, and was exerted in the interest of the aristocratic party. The democratic party strenuously opposed the growing power of the order, and their enmity caused Pythagoras to retire to Metapontum, where he died about 506 B.C. His system appears to owe very much to a vivid imagination acting upon prevailing ignorance respecting the order of nature. What was not known was guessed at, with the usual result. In the case of Pythagoras, as in that of other teachers of those early times, the popular effect of this partial knowledge was heightened by mingling it with secret doctrines. One of these doctrines was the transmigration of souls; and Pythagoras is said to have believed himself to have previously lived in several bodies. This doctrine of the transmigration of souls (*metempsychosis*), which was originally Egyptian, and connected with the idea of the reward and punishment of human actions, was the chief reason why the Pythagoreans killed no animals. Pythagoras had also abstruse theories respecting numbers, geometry, and music, which he valued very highly as fitting the soul for contemplation. The proof of the 47th proposition of the first book of Euclid's *Elements* is attributed to him. The effect of his teaching, however, was such that his disciples are said to have paid him divine honours after his death. In appearance he was grave, commanding, and dignified. He abstained from all animal food, limiting himself to a vegetable diet. His public instruction consisted of practical discourses in which he recommended virtue and dissuaded from vice, with a particular reference to the various relations of mankind, as those of husbands and wives, parents and children, citizens and magistrates, &c. His disciples were required to practise the greatest purity and simplicity of manners. He imposed upon them, it is said, a silence of from two to five years, according to circumstances. He alone who had passed through the appointed series of trials was allowed to hear the word of the master in his immediate presence. To the initiated the doctrines were not delivered, as to others, under the mask of images and symbols, but unveiled. The mysti-

cism of his philosophy was derived by Pythagoras from the Orphic hymns (see *Orphism*). Pythagoras left no writings; the *Golden Sentences* extant under his name having been composed or compiled by later hands. The Pythagorean philosophy had a great influence on the Platonic, and in later times it was revived and intermingled with Neo-Platonism (q.v.).—Cf. T. Gomperz, *Greek Thinkers*.

Pyth'eas, Greek astronomer and geographer, a native of the colony of Massilia (Marseilles), supposed to have lived about the time of Alexander the Great (say 330 B.C.). He is reputed to have sailed along the west coast of Europe, entered the English Channel, and travelled some distance in Britain, then, continuing his journey northward, to have arrived at Thule (supposed to be Iceland). In a second voyage he entered the Baltic, where he proceeded as far as a river which he called Tanais, and on the banks of which amber was found. We only know of him through Strabo, Pliny, and others.

Pythian Games, one of the four great Grecian games, instituted in honour of Apollo. They were celebrated in the neighbourhood of Delphi (formerly called Pytho), in the Crissæan fields. According to the popular mythological legend, the Pythian games were instituted by Apollo himself. Until about 586 B.C. they were under the management of the Delphians, and took place every eighth year; but after that date they were conducted by the Amphictyons, and celebrated every fourth year, prizes being given for flute-playing, athletic sports, and horse- and chariot-racing. Eventually contests in tragedy, painting, sculpture, &c., were added. At first prizes of silver or gold were awarded, but afterwards the simple laurel wreath and palm-branch were substituted. They continued to be celebrated until the end of the fourth century of our era.

Pythium. See *Damping-off Disease*.

Python, a genus of snakes forming a subdivision of the family Boidæ or Boas. They are not venomous, but kill their prey by compression. The pythons belong exclusively to the hotter parts of the Old World (except one species in South Mexico), and are of enormous size, sometimes attaining a length of 30 feet. They are found in India and in the islands of the Eastern Archipelago, in Africa, and in Australia. A rudimentary pelvis and traces of hinder limbs exist in the pythons, these structures terminating externally in a kind of hooked claw. The head exceeds the neck in thickness, and the mouth is extremely large. Aided by their prehensile tails and rudimentary hinder limbs, the pythons suspend themselves from the branches of trees and lie in wait near water

for animals which come to drink. The genus Python contains various species, the best known of which is the West African python (*P. sebae*), common in menageries; while *P. spilotes* is the carpet-snake of Australia and New Guinea. The



Python (*Python regius*)

female python hatches her eggs with the heat of her body.

Pyx, **Trial of the**, the final trial by weight and assay of the gold and silver coins of the United Kingdom, prior to their issue from the Mint. The *pyx* is a chest in which one coin from every 15 lb. of newly coined gold, and one from every 60 lb. of silver, are set aside to await the test. The trial takes place periodically before a jury of goldsmiths summoned by the Lord Chancellor, and constitutes a public attestation of the standard purity of the coin. The term is also applied to the assaying of gold and silver plate, which takes place at the different assay offices.

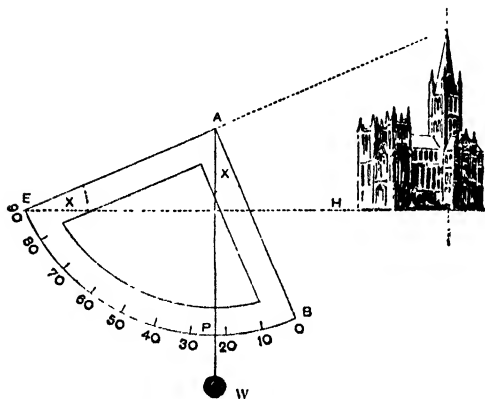
Pyxid'ium, in botany, a capsule with a lid, as seen in henbane and in the fruit of *Lecythis Ollaria*, the monkey-pot tree, a large forest tree of Brazil.

Q

Q, the seventeenth letter in the English alphabet, a consonant having the same sound as *k* or hard *c*. It is a superfluous letter in English, as the combination *qu*, in which it always occurs, could be equally well expressed by *kw* or *k* alone when the *u* is silent. It did not occur in the Anglo-Saxon alphabet, the sound *qu* in Anglo-Saxon words being regularly written *cw* or *cu*, but was borrowed from the French-Latin alphabet.

Quadri, a Germanic people of the Suevic race, whose ancient territory was on the Danube, extending to the Theiss on the east and to the Carpathian Mountains on the north. They long waged destructive wars with the Romans, particularly under Marcus Aurelius, but cease to be heard of in the fifth century, having probably migrated farther west with the Suevi.

Quadrant, (a) the fourth part of the circumference of a circle; (b) the fourth part of



the area, viz. that included between the circumference and two perpendicular radii; (c) an instrument formerly used for taking altitudes in navigation, astronomy, gunnery, and surveying. The essential part of the instrument is an arc of a circle graduated into degrees and parts of degrees. The principle of one simple type is shown in the figure. The eye at *E* observes an object in the direction *EA*. *AW* is a plumb-line attached at *A*. The angle between *EA* and the horizontal line *EH* is equal to the angle *BAP*, if *EAB* is a right angle. The angle *BAP* is read from the arc *BP*. The quadrant has been superseded by more efficient instruments, the mural circle (q.v.) in astronomy, and the sextant (q.v.) in navigation.

Quadrate Bone, a bone developed in reptiles and birds, by means of which the lower jaw is

articulated or joined to the skull. The lower jaw of these forms is thus not hinged directly or of itself to the skull, as in mammals.

Quad'rature, in astronomy, the position of the moon or a planet when its longitude differs from that of the sun by 90°.

Quadrilat'eral, a name given to the space enclosed between, and defended by, four fortresses in Northern Italy famous in Austro-Italian history, namely, Peschiera and Mantua on the Mincio, and Verona and Legnago on the Adige.

Quadrille', a dance of French origin, which consists generally of five consecutive figures or movements, danced by four sets of couples, each forming the side of a square. It originated in the French ballets of the eighteenth century, but in its modern form dates from the beginning of the nineteenth century.

Quadru'mana ('four-handed'), the name applied by Cuvier and others to denote the order of mammalia represented by the lemurs, monkeys, and apes, from the fact that these forms agree in possessing a great toe so constructed as to be capable of opposing the other digits of the feet, instead of being placed parallel with the other toes, thus forming a kind of 'hand' adapted for supporting the foot on the ground. This conversion of the feet into hand-like organs presented to Cuvier's mind a structure so remarkable and so different from the disposition of the feet and toes of man, that he separated man as a sole and single genus to represent the distinct and opposing order of Bimana or 'two-handed' mammalia. But in modern zoology man is generally included in one order with the apes, monkeys, and lemurs, the order Primates, of which man constitutes a distinct family. As limited to the apes, monkeys, and lemurs, the Quadrumana are characterized by the following points: The hallux (innermost toe of the hind-limb) is separated from the other toes, and is opposite to them, so that the hind-feet become prehensile hands. The pollex (innermost toe of the fore-limbs) may be wanting, but when present it also is usually opposable to the other digits, so that the animal becomes truly quadrumanous, or four-handed. The teats are two in number, and the mammary glands are on the chest as in man, though some lemurs have abdominal ones in addition, and in the males of one genus (*Hapalemur*) there is a mammary gland on each shoulder. See *Monkey*; *Ape*; &c.

Quadruple Alliance, an alliance, so called from the number of the contracting parties,

concluded in 1718 between Great Britain, France, and Austria, and acceded to by Holland in 1719, for the maintenance of the Peace of Utrecht. The occasion of the alliance was the seizure by Spain of Sardinia in 1717, and Sicily in 1718, both of which she was forced to give up. Another quadruple alliance was that of Austria, Russia, Great Britain, and Prussia, in 1814, originating in the coalition which had effected the dissolution of the French Empire. Another quadruple alliance was the league formed in 1840 by Austria, Prussia, Russia, and Great Britain for the purpose of protecting Turkey against the threatening power of Mehmet Ali (q.v.).

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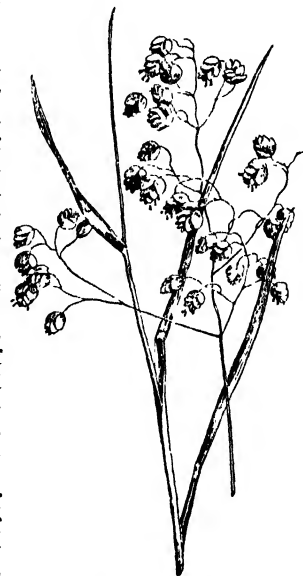
Quain, Sir Richard, British physician, born at Mallow, County Cork, in 1816, died in 1898. He became a member of the Royal College of Physicians in 1846, Fellow in 1851, and subsequently vice-president and member of the council. Besides publishing several medical treatises, he edited a well-known *Dictionary of Medicine*.

Quakers. See *Friends, Society of*.

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Quantification of the Predicate, in logic, the use of some word or words to indicate whether the predicate of a proposition is distributed or not, that is, whether or not all the objects of which the predicate may be asserted are also objects of which the subject may (in affirmative propositions) be asserted or (in negative propositions) denied. Thus, when we say *Some men are logicians*, we do not know from the form of the proposition whether we may not apply the predicate logicians to any who are not men, but if we quantify the predicate and say *Some men are all logicians*, we at once show that this application cannot be made. Ploucquet and Lambert in the eighteenth century suggested the quantification of the predicate, but Sir William Hamilton was the first to give prominence to the doctrine by the importance that he attached to it, considering it as involving a complete revolution in formal logic. The doctrine of the quantification of the predicate was attacked immediately after his enunciation of it, and it has never been generally adopted in the exposition of formal logic.

Quantock Hills, a range of low elevation of Somerset, England, extending from the Bristol Channel, near Watchet, south-east to between Bridgewater and Taunton, the culminating point being Will's Neck (1261 feet altitude).

Quantum Theory. The principles of classical mechanics involve the assumption that the mechanical states of any system form a continuous series (i.e. that there is a mechanical state intermediate between any two such states), and that a system passes from one mechanical state to another through the states intermediate between them. On the other hand, quantum theories involve the assumption that the possible states (called 'quantum states') of a system form a discontinuous series, and that the system passes from one quantum state to another without passing through any intermediate state. Thus, while classical mechanics holds that a particle in changing its velocity must pass through all velocities intermediate between the initial and final velocity, a quantum theory applicable to such a particle would hold that it passes through only a finite number of discrete velocities, changing abruptly and without intermediate steps from one of these velocities to another.

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1. It is an experimental fact that when an electron absorbs energy from or gives energy to radiation, it always absorbs or gives an amount of energy $h\nu$, where ν is the frequency of the radiation; the amount is independent of the intensity of the radiation and of the constitution of the system to which the electron belongs. Such facts are found in the photo-electric effect (q.v.) in secondary β -radiation excited by X-rays, and in the excitation of spectrum lines by moving electrons (see *Spectra, Theory of*). This double independence is inexplicable by any 'continuous' theory. Quantum theory explains it by asserting as a fundamental principle that the quantum states of radiation of frequency ν have energies equal to $m h \nu$, and that by reaction

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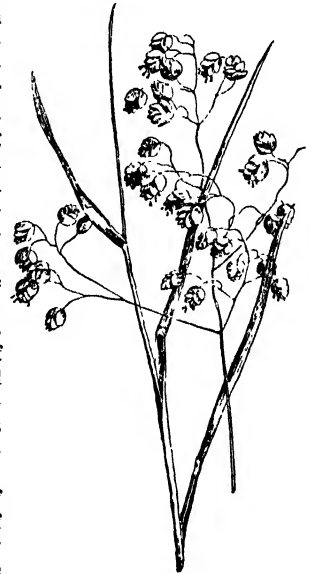
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with an electron only those changes are possible in which m changes by 1. An alternative theory is that the electron which takes part in these changes of energy belongs to an 'oscillator' with a frequency equal to that of the radiation, that the quantum states of this oscillator have an energy $m h \nu$, and that m can only change by 1; but this older theory is now generally abandoned and the quantum states assigned to the radiation, not to the electron.

2. The relation found experimentally between the wave-length and the intensity of the complete temperature radiation emitted from a body and the temperature of that body is definitely irreconcilable with the principles of classical mechanics (see *Radiation, Theory of*). This discrepancy led historically to the formulation (by Planck in 1900) of the first quantum theory; but it is remarkable that the direct evidence for a quantum theory is much less obvious in connection with the laws of temperature radiation than with any of the other laws to which such theories are applied. For since, according to thermodynamic theory, temperature is a conception applicable only to a system consisting of a very large number of individually independent elements, all laws involving temperature must be regarded as fundamentally statistical; and such laws are not expected to show the discontinuities characteristic of quantum changes. Nevertheless, though in this case the experimental laws to be explained give no indication of discontinuity, the only satisfactory explanation of them that has been offered is based on the assumption that they represent an average of elementary laws that are essentially discontinuous. Here again there has been some doubt whether the discontinuous quantum states should be assigned to the radiation or to the material system with which it reacts; but the tendency is towards accepting the former view and adopting the same criterion of quantum states as in (1). The problem then arises of determining how the distribution of the total energy of the radiation among the possible quantum states will depend on the temperature. It is solved by means of Boltzmann's equation (see *Thermodynamics*) relating the entropy S (which is a function of the energy and the temperature) to W , the probability of the given state; the probability is defined as the ratio of the number of 'complexions' which all represent that physical state to the total number of possible complexions; and each possible distribution of the energy among the different quantum states represents a different complexion. From these assumptions Planck's law of radiation can be deduced, though it is not perfectly certain that a deduction completely logical has been given. It follows that the energy of an oscillator of

natural frequency ν in thermal equilibrium with complete radiation at temperature T (and therefore forming part of a body at that temperature)

$$\text{is } L_\nu = \frac{h\nu}{e^{h\nu/RT} - 1}.$$

3. Closely allied with (2) is the explanation of the laws relating the specific heat of bodies to the temperature or to other properties (e.g. magnetic properties) which depend upon the mean energy of the molecules. In virtue of the conclusions of (2), the deduction of such laws requires only a knowledge of the proportions in which oscillators of various frequencies are present in the body. In a gas these oscillators are supposed to consist of the rotating molecules, the frequency of rotation being the frequency of oscillation. In a solid body they consist of the various stationary elastic oscillations which can be maintained in the body by reason of its rigidity and compressibility. Calculations on this basis give a most remarkable agreement between experiment and theory, not merely in the relation between specific heat and temperature, but also in the relation between specific heat and the moment of inertia of gaseous molecules or the elastic constants (and indeed all mechanical properties) of the solid. Two subsidiary results of interest follow: (1) the absorption-band in the infra-red spectrum, characteristic of any solid, represents the elastic oscillation of highest frequency which the body can perform; (2) the mean energy of an oscillator at the absolute zero of temperature is not zero (as classical theory would predict) but $h\nu/2$, where ν is its frequency.

4. The most elaborate quantum theory has been developed by Bohr and Sommerfeld to define quantum states of the atom, the existence of which is clearly indicated by the study of spectra (see *Spectra, Theory of*). Here we are concerned (see *Matter, Atomic Theories of*) with systems of electrons and positively charged nuclei, held together and apart by electrostatic forces, and executing orbits of many degrees of freedom which are periodic in the most general sense. The orbits which represent quantum states are (as usual) assumed to be such as would be possible according to classical principles, but are selected from among those so possible by a certain criterion. The orbits can be calculated with perfect certainty when there is only one electron associated with the nucleus; the orbits are then ellipses (or, more accurately, differ very slightly from ellipses in virtue of the 'relativity' correction); there are two periodic co-ordinates, the radius from the focus and the angle between the radius and some fixed line; there are accordingly two quantum numbers, called respectively the

'radial' and the 'azimuthal'. Since either of these numbers can assume any positive integral value, there is a doubly infinite (and yet discontinuous) series of quantum states for such an electron. The energy of the electron is determined mainly by the sum of the two quantum numbers, or 'total' quantum number, and is nearly the same for all states for which it is the same. The normal state of the atom (see *Matter*) is that for which it is 1.

In spite of these notable successes, quantum theory is not yet complete. Some of the most serious difficulties occur in the theory of radiation (q.v.); generally the theories are much less developed for prediction of what changes will occur than for prediction of the energy redistributions which accompany those changes. But it may be asserted with perfect confidence that the quantum theory will be the foundation of all atomic and molecular physics in the future. See *Radiation, Theory of*; *Spectra, Theory of*.

Quar'antine (It. *quarantina*, a space of forty days), the period (originally forty days) during which a ship coming from a port suspected of contagion, or having a contagious sickness on board, is forbidden intercourse with the place at which she arrives. This form of quarantine is now confined to foreign countries where cholera, yellow fever, &c., have to be guarded against. In Britain the Quarantine Act of 1825 has been repealed, and replaced by the Public Health Act of 1904. Quarantine was originally introduced at Venice as a measure of protection against plague or leprosy about the middle of the fourteenth century, Venice, then the chief trading centre of the Mediterranean, being especially liable to contagion through vessels coming from Eastern ports. A lazaretto was early erected there in connection with the quarantine restrictions.—Cf. Sir S. Baker, *Laws relating to Quarantine*.

Quarles, Francis, English poet, born in 1592 near Romford, in Essex, died in 1644. Educated at Christ's College, Cambridge, he entered at Lincoln's Inn, and in 1613 was appointed cup-bearer to Elizabeth, Queen of Bohemia. In 1629 he went to Dublin as secretary to Archbishop Ussher. He appears to have left Ireland before 1633 and to have settled in Essex, and in 1639 he was appointed chronologer to the city of London. At the commencement of the Civil Wars he joined the king at Oxford and wrote some pamphlets, including *The Loyal Convert*, which gave offence to the Parliament. His property was sequestered, and his manuscripts destroyed. He was so much affected by his losses that grief is supposed to have hastened his death. Of the works of Quarles, in prose and verse, the most celebrated is his *Emblems*, a set of designs illustrated by verses. Among his

poems are *Divine Poems*, *Divine Fancies*, and *Argalus and Parthenia*. His *Enchiridion* is a collection of brief essays and aphorisms, in vigorous and occasionally eloquent language.

Quarne'ro, Gulf of, in the Adriatic Sea, between Istria, Italy, and the Croatian coast, in Yugo-Slavia, 15 miles in length and breadth. It is nearly enclosed leewards by the Islands of Cherso and Veglia, and communicates with the Adriatic by three channels.

Quarter-day, in England, the day that begins each quarter of the year. These are Lady Day (25th March), Midsummer Day (24th June), Michaelmas Day (29th Sept.), Christmas Day (25th Dec.). These days have been adopted between landlord and tenant for entering or quitting lands or houses and for paying rent. In Scotland the legal terms are Whitsunday (15th May) and Martinmas (11th Nov.); the conventional terms Candlemas (2nd Feb.) and Lammas (1st Aug.) make up the quarter-days.

Quarter-deck, in sailing-ship parlance, the upper deck, or aftermost part of the upper deck, of a vessel, extending from the main-mast to the stern, or to the poop (when there is one). In the modern navy the quarter-deck is the after-deck of a warship, and below it are the quarters of the officers. Before the Reformation a crucifix was invariably erected over the poop, and was, of course, saluted as a mark of respect by all hands. To this day the custom is maintained of 'saluting the quarter-deck', both on board ship and in naval depots, although the original object of the honour has long since disappeared.

Quartermaster, in the army, an officer who attends to the quarters for the soldiers, their provisions, fuel, forage, &c. There is a quartermaster attached to every battalion, &c., who generally holds the rank of honorary lieutenant but does not sit in the officers' mess. Quartermaster-sergeants are subordinate to the quartermasters, whose assistants they are in theory if not in practice, and who administer the companies of a battalion (or other units of standard) under his direct guidance and control, although they are also responsible to the captains of the units to which they are posted.

Quartermaster-General, a staff officer of high rank in the army, whose department is charged with all orders relating to the marching, embarking, disembarking, billeting, quartering, and cantoning of troops, encampments and camp equipage. The quartermaster-general is attached to a whole army under a commander-in-chief, and generally holds the rank of major-general, while to every division is attached a deputy-assistant quartermaster-general.

Quarter-sessions, in England, a general

court of criminal jurisprudence held quarterly by the justices of the peace in counties, and by the recorder in boroughs. The jurisdiction of these courts, originally confined to matters touching breaches of the peace, has been gradually extended, and it now comprises almost all crimes except murder and treason. Appeals from the magistrates' courts are also taken to the quarter-sessions. There is also an extensive jurisdiction in matters relating to the settlement of the poor, highways, vagrancy, bastardy, &c., in most of which cases an appeal lies to the higher courts. In Scotland the quarter-sessions are a court held by the justices of the peace four times a year at the county towns. These courts have the power of reviewing the sentences pronounced at the special and petty sessions when the sentence is of a nature subject to review. The offences dealt with are only petty offences. Such cases as fall to be tried by the English courts of quarter-sessions are chiefly disposed of in Scotland in the sheriff courts of the county.

Quarter-staff, an old English weapon formed of a stout pole about $6\frac{1}{2}$ feet long, generally loaded with iron at both ends. It was grasped by one hand in the middle, and by the other between the middle and the end. In the attack the latter hand shifted from one quarter of the staff to the other, giving the weapon a rapid circular motion.

Quartet is the name given in music to a composition written in four parts, either for voices or instruments; but when the term is used without qualification, a quartet consisting of two violins, a viola, and a 'cello is always understood. Music may be written in any desired number of parts, and Thomas Tallis, who wrote in the contrapuntal era, has one composition for voices with the exceptional number of forty. The quartet, however, is a product of the harmonic era, and has its foundation in four-part harmony, which forms the basis of the great bulk of concerted music.

The two violins, viola, and 'cello, which invariably constitute the string quartet, are analogous in their more extended sphere to the soprano, alto, tenor, and bass of the human voice. In the early days of writing music for this and other combinations of instruments it was natural that composers should do many crude things, since they were writing for a medium in which they were totally inexperienced; and an examination of the first string quartets of Haydn, who was the father of this branch of composition, reveals, among other faults, this serious one, that the main interest of the music was too exclusively confined to the top part. Mozart was the first composer to demonstrate the possibility and the necessity of making all

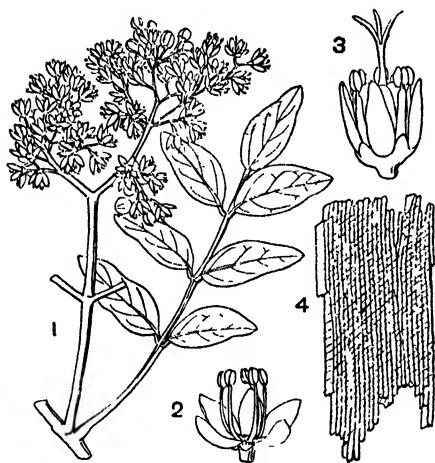
four parts of equal musical interest and importance. His immortal set of six quartets, dedicated to Haydn, are particularly complete examples of how such works should be written, and Haydn himself was the first to profit by the demonstration. Since then the string quartet has been a favourite medium of expression for all serious-minded composers, and men like Beethoven, Schubert, Brahms, and many others have enshrined in this medium some of their finest music. In the so-called pianoforte quartets this instrument is generally associated with a violin, viola, and 'cello, and there are also many fine works written for this combination. Quartets for a combination of strings and wind-instruments are rare, while vocal quartets are so common and so frequently heard that there is no occasion for any comment regarding them.

Quartz, a generic term for most of the native forms of crystallized silica, SiO_2 . It may occur in the form of well-defined crystals, such as rock-crystal. These crystals are usually formed of a hexagonal prism terminated by hexagonal pyramids, but the latter are formed by the union of two rhombohedra, and the frequent occurrence of certain oblique planes shows that quartz really crystallizes in a low class of the trigonal system. Quartz also occurs in masses and in veins in igneous and metamorphic rocks; such veins frequently contain traces of gold. It is hard, scratches glass readily, and was formerly used by North American Indians for arrow-heads. When struck with steel it produces sparks, and when rubbed it becomes electrified. It is a constituent mineral of numerous igneous rocks, such as granite. The colours are various, as white or milky, grey, reddish, yellowish or brownish, purple, blue, green. The principal varieties of quartz are the following: (1) *rock-crystal*, the original transparent mineral to which the term crystal was applied, from its resemblance to ice; (2) *smoky quartz*; (3) *citrine*, or *yellow quartz*; (4) *amethyst*; (5) *rose quartz*; (6) *milky quartz*; (7) *carnelian*; (8) *chrysoprase*. Smoky quartz consists of crystals and crystalline masses which are translucent and of a purplish-brown colour. *Bohemian* or *Scottish topaz* and *cairngorm* are forms of transparent yellow quartz. Amethyst is violet and transparent. Milky quartz, the common quartz of veins, is massive and of a milk-white colour. Carnelian has a blood-red colour. Chrysoprase is apple-green. Chalcedony, flint, and jasper (q.v.) are compact forms of crystalline silica, and probably consist of quartz in minute fibres or granules. (See *Agate*.) Several varieties of quartz are important in arts and manufactures. At present quartz is employed not only for cups, urns, &c., but for seals, spectacle-glasses, and optical instruments. Quartz is largely used

for the manufacture of glass, both white and coloured, and also of porcelain and other kinds of pottery, when it is added in the state of an impalpable powder, and forms part of the paste. Quartz is used as a flux in smelting various ores, particularly those of copper, and in other metallurgical processes. Quartz fused in the oxy-hydrogen blow-pipe is drawn out into thin fibres as silica-glass, for the suspension of delicate torsion-balances or for the cross-threads in microscopes. Silica-glass does not crack when suddenly heated and resists most acids, and has found a wide use in laboratories when moulded into flasks and other vessels.

Quartzite, a stratified granular-crystalline rock consisting entirely, or almost entirely, of quartz. It is a sandstone which has been cemented by silica; and this silica is deposited as quartz around the primary sand-grains, until an interlocked granular structure arises. Quartzites are conspicuous among older stratified series; but the rock is not necessarily of metamorphic origin. It is generally of a greyish colour, or is pinkish from a slight trace of iron.

Quassia is a genus of South American tropical plants, consisting of trees and shrubs, nat. ord.



Quassia (Picræna excelsa)

1, Leaves and flowers. 2, Male flower (enlarged). 3, Hermaphrodite flower (enlarged). 4, Cross-grained slice of wood (the 'Quassia' of trade).

Simarubaceæ. The wood of two species is known in commerce by the name of *Quassia*; *Q. amara*, a native of Panamá, Venezuela, Guiana, and Northern Brazil, a small tree with handsome crimson flowers; and *Q. excelsa (Picræna excelsa)*, Lindley), a native of Jamaica. The latter furnishes the *lignum quassiae* of the *British Pharmacopœia*. Both kinds are imported in billets, and are inodorous but intensely bitter, especially

the Jamaica quassia. *Quassia* is a pure and simple bitter, possessing marked tonic properties. An infusion of quassia sweetened with sugar is useful to destroy flies. *Q. excelsa* was formerly substituted by some brewers for hops, but is now prohibited under severe penalties. See *Bitter-ash*.

Quaternions, a mathematical calculus invented by Sir William Rowan Hamilton (q.v.). It can be regarded either as an algebra, or as a geometry specially applicable to three-dimensional space. In plane geometry $x + iy$ represents the vector from the origin to the point (x, y) . Hamilton introduces the analogous form $ix + jy + kz$ for the vector from the origin to (x, y, z) . The symbols i, j, k therefore represent unit vectors parallel to the axes of co-ordinates; and the combination by addition of the vectors ix, jy, kz corresponds to the geometrical composition of these into one vector by the parallelogram law. Like i in plane geometry, the quaternion symbols i, j, k are roots of -1 . Taking the point of view that quaternions is a generalized algebra, we assign, simply by way of definition, the laws of combination of the symbols $i, j, k, 1$. It is laid down that addition is to be commutative, and that multiplication is to be subject to the following laws of combination of i, j, k :

$$ij = k = -ji, jk = i = -kj, ki = j = -ik, \\ ijk = -1, i^2 = j^2 = k^2 = -1.$$

Multiplication is accordingly not commutative, ij and ji , for instance, having opposite signs. If we multiply by these rules the two vectors $ix + jy + kz$ and $ix' + jy' + kz'$, the work runs:

$$ix(ix' + jy' + kz') + jy(ix' + jy' + kz') + \\ kz(ix' + jy' + kz') \\ = i^2xx' + jxy' + ikxz' + &c. \\ = -(xx' + yy' + zz') + i(yz' - y'z) + \\ j(zx' - z'x) + k(xy' - x'y).$$

The product of two vectors has therefore the form $w + ia + jb + kc$; it is this type of expression of four terms which is called a *quaternion*. The term w is called the *scalar* part of the quaternion $w + ia + jb + kc$ ($= q$); and the remaining terms are called the *vector* part. These two parts are written Sq and Vq , so that $q = Sq + Vq$. It will be observed that the expressions found for Sq and Vq correspond to geometrical entities which have important relations to the two vectors which were multiplied together. Thus $xx' + yy' + zz'$ is the product of the absolute magnitudes r, r' (called the *tensors*) of the two vectors by the cosine of the angle θ between them; and the coefficients of i, j, k in the product are the components, parallel to the axes, of the vector whose direction is perpendicular to the plane of

the two vectors, and whose absolute magnitude is $rr' \sin \theta$.

Again, the vector operator $id_x + jd_y + kd_z$ (where d_x signifies the operation of differentiation d/dx) when applied to the vector $iX + jY + kZ$ gives the result $-(dX/dx + dY/dy + dZ/dz) + i(dZ/dy - dY/dz) + j(dX/dz - dZ/dx) + k(dY/dx - dX/dy)$; the scalar and vector parts here are of very great importance in mathematical physics. The scalar part is called the *convergence* (if without the minus sign, the *divergence*) of the vector X, Y, Z ; and the vector part is called the *curl* of the vector X, Y, Z .

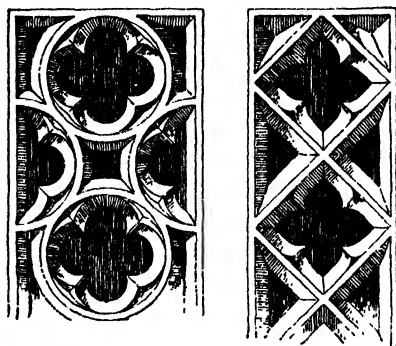
The existence of relations such as those above makes the method of quaternions very suggestive for geometry and physics. Opinions have differed on the question of its value as a practical working calculus. Hamilton himself, and P. G. Tait, his chief interpreter, were enthusiastic on the subject; Kelvin, on the other hand, thought the method of extremely little use. It ought to be said that the expositions of Hamilton and Tait are geometrical rather than algebraical. Some parts of the notation have become the common property of physicists—Clerk Maxwell, e.g. in his *Electricity and Magnetism* uses it a good deal—but beyond this the method plays only a small part in modern physical investigations.—BIBLIOGRAPHY: C. J. Joly, *Manual of Quaternions*; P. G. Tait, *Quaternions*.

Quatre-Bras (kâ-tr-brä), a village of Belgium, in the province of Brabant, situated at the intersection of the main roads between Brussels and Charleroi, and from Nivelles to Namur. It is famous for the battle fought here (16th June, 1815) between the British under Wellington and the French under Ney.

Quatrefages de Bréau (kâ-tr-fâzh dé brä-ô), Jean Louis Armand de, French naturalist, born in 1810, died in 1892. He took his M.D. degree at Strasbourg in 1838; and was professor of zoology at Toulouse, the Lycée at Paris, and professor of anatomy and ethnology at the Musée d'Histoire Naturelle there. He was elected a member of the Royal Society, London, i. 1879. His contributions to science include numerous researches into the lower grades of life, and a valuable series of anthropological studies. Among his more important works are: *Souvenirs d'un naturaliste* (1854), *Crania ethnica* (1875-9), *De l'espèce humaine* (1877), *Hommes fossiles et hommes sauvages* (1883), *La Distribution géographique des négritos* (1883), *L'Homme tertiaire* (1885), *Les pygmées* (1887), and *Histoire générale des races humaines* (1886-9).

Quatrefoil (kwâ'tér-foil), in architecture, an opening or a panel divided by cusps or foliations into four leaves, or more correctly the leaf-shaped figure formed by the cusps. It is an ornament which has been supposed to represent

the four leaves of a cruciform flower, and is common in the tracery of Gothic windows. Bands of small quatrefoils are much used as ornaments in the perpendicular Gothic style, and sometimes in the decorated. The same



Quatrefoil Panels, King's College Chapel, Cambridge

name is also given to flowers and leaves of similar form carved as ornaments on mouldings.

Quéant, a village of France, in the department of Pas-de-Calais. During the European War it was a pivot of the 'Drocourt-Quéant switch line', which branched off from the main Hindenburg Line at Quéant and ran in the rear of the more advanced position, serving as a support to it. This line covered the railways which ran from Boisieux-au-Mont eastwards to Cambrai, from Arras to Douai, and that which proceeded from Lens south-eastward to the Arras-Douai line and Cambrai. As a result of the Allied successes of Aug., 1918, a position was attained which threatened the Hindenburg Line, Germany's main defence, and that at its most dangerous point, the salient where it joined the Drocourt-Quéant line north-west of Quéant. On 2nd Sept., 1918, troops of the British First and Second Armies moved forward, and after seven hours' hand-to-hand fighting the Drocourt-Quéant line was completely cleared. The troops taking part were the 63rd (Royal Naval) Division under Major-General C. A. Blacklock, 1st and 4th Canadian Divisions, 4th English Division, the 52nd and 57th Divisions, and the 3rd Tank Brigade (40 tanks), assisted by Canadian cavalry and armoured-cars and a mobile force of motor machine-guns.

Quebec, an eastern province of the Dominion of Canada.

Area and Population.—The total area is 703,353 sq. miles, of which 15,969 sq. miles are water. The population in 1911 only covered the area of Quebec prior to the annexation of Ungava in 1912, and represents, therefore, an

area of only 351,878 sq. miles. In that year there were 2,008,232 inhabitants (1,011,502 being males), which represents a density of only 5.69 per square mile. Of this population over 1,500,000 were of French origin and 300,000 British. The estimated population for 1921 was 2,500,000.

Towns.—The principal towns and their populations (1921) are: Montreal (758,045); Quebec, the capital (116,850); Hull (32,766); Verdun (28,982); and Three Rivers (25,000).

Physiography.—The chief mountains are the Notre Dame or Shickshock Mountains, extending along the south side of the St. Lawrence, and forming a tableland 1500 feet high, with peaks rising to the height of 4000 feet; and the Laurentian Mountains, or Laurentides, which stretch from the coast of Labrador to the Ottawa River, and rise to a height of from 1200 to 4000 feet. The chief islands are Anticosti, at the mouth of the St. Lawrence, and the Magdalen Islands in the Gulf of St. Lawrence. The chief river is the St. Lawrence, which flows through the entire length of the province. Next to it in importance is its chief tributary, the Ottawa, over 700 miles in length. The other largest rivers are the St. Maurice and the Saguenay. The province boasts many beautiful lakes, among the chief being St. John. It has also abundant water-power. The valleys of the St. Lawrence and the Ottawa are the chief seat of population.

Production.—The soil is generally fertile, and well suited for the growth of cereals, hay, &c.; maize, flax, and tobacco are grown, especially to the west of the longitude of Quebec, also grapes, melons, peaches, tomatoes, &c. Dairying and stock-rearing are flourishing industries. A large portion of the province is covered with forest, and great quantities of pine lumber and pulp wood are taken out. The fisheries are extensive and valuable. The minerals worked include apatite, asbestos, gold, copper, iron, plumbago, &c. The manufactures include furniture, leather, paper, paper-pulp, boots and shoes, woollens, cottons, cheese, butter, condensed milk, iron, hardware, soap, maple sugar, maple syrup, flour, and agricultural implements and machinery.

Education.—The educational system embraces institutions of all grades, from primary schools upwards, at the top being three universities—Laval University, Montreal and Quebec (Catholic); McGill University, Montreal; and Bishop's College, Lennoxville (Anglican).

Government.—The affairs of the province are administered by a Lieutenant-Governor (appointed by the Governor-General) and a responsible ministry assisted by a Legislative Council of 24 members, appointed for life, and a Legis-

lative Assembly of 81 members, elected for 5 years. Women are not enfranchised, and are not eligible for election to Legislature.

Quebec, a city and shipping-port of the Dominion of Canada, capital of the province of the same name, situated on a promontory near the confluence of the St. Charles with the St. Lawrence, terminating abruptly in Cape Diamond, which has a height of 333 feet, and on the banks of both streams. It is about 400 miles from the mouth of the St. Lawrence and 140 miles north-east of Montreal, to which the river is navigable for large vessels. The Canadian Pacific Railway and the Canadian National Railway are the principal trunk lines. Quebec is one of the most picturesque and interesting of American cities. It is divided into the upper and lower towns. The former, placed on the summit of the promontory, is strongly fortified, the fortifications comprising a citadel and other works. The view from the heights here looking down the river is one of the finest in the world. The lower town, the great seat of business, lies under the cliffs, along the St. Lawrence and the St. Charles. Among the principal edifices are the Parliament and departmental buildings, the Roman Catholic cathedral, the Protestant cathedral, and Château Frontenac (hotel). The chief educational institutions are Laval University, with faculties of law, medicine, theology, and arts, and a library of 150,000 volumes; the Grand Seminary; and the Ursuline convent, a large and fashionable ladies' school. On the Plains of Abraham, west of the upper town, is a column in memory of General Wolfe; there is also a handsome obelisk to the joint memory of the two commanders, Wolfe and Montcalm, who both fell at the taking of Quebec in 1759. The industries embrace iron castings, machinery, cutlery, nails, leather, paper, india-rubber goods, ropes, tobacco, beetroot-sugar, &c. Quebec is the chief seat of the Canadian trade in timber, and at certain seasons rafts of timber may be seen extending along the water's edge for 6 miles.

The harbour of Quebec is on the St. Lawrence River, and comprises the river and its navigable tributaries between St. Patrick hole and Cape Rouge. It affords wharfage accommodation for twenty-five to thirty ocean-going vessels; water from 24 to 40 feet, with a large amount of extra space for small vessels. There are gantry and locomotive cranes available at all times for handling cargo. The average navigation season is between 1st April and 1st Dec. There are a tidal harbour, wet dock, and two graving-docks, and two trunk lines of the Canadian Pacific and Canadian National Railways have access to the wharves. There is a grain-elevator of

250,000 bushels capacity, and one of 2,000,000 bushels capacity.

Quebec was founded in 1608 by Champlain, who was sent on an exploring expedition from France. In 1629 it came into the hands of the English, but was restored in 1632. In 1759 it became finally British in consequence of Wolfe's victory on the Plains of Abraham. The Plains were nationalized at the celebration of the tercentenary of the foundation of Quebec in 1908. The great bulk of the inhabitants are Roman Catholic French Canadians. Pop. (1921), 116,850.

Quebracho (ke-brä'chō), the name given to several trees of different genera, but with similar qualities, indigenous to South America, valuable alike for their wood and their bark. The red quebracho (*Loxopterygium* (*Quebrachia*) *Lorentzii*, family Anacardiaceæ) is very hard, but splits easily. The bark and wood are used in tanning. The white quebracho (*Aspidosperma quebracho*) is used for wood-engraving. The bark contains six alkaloids, and is used therapeutically as a remedy for asthma, usually as a tincture.

Quedlinburg (kwed'lin-burh), a town of Prussia, in Saxony, at the foot of the Harz Mountains. On an eminence above the town is an old castle, once the residence of the abbesses of Quedlinburg, who, as princesses of the empire, had a vote in the Diet. Founded by Henry the Fowler in 924, Quedlinburg was a Hanseatic town till 1477. The manufactures are woollens, beetroot - sugar, wire, leather, chemicals, &c. Pop. 27,000.

Queen, a term designating a woman ruler holding a position similar to that of king. In Britain the queen is either *queen-consort* or merely wife of the reigning king, who is in general (unless where expressly exempted by law) upon the same footing with other subjects, being to all intents the king's subject, and not his equal; or *queen-regent*, regnant, or sovereign, who holds the crown in her own right, and has the same powers, prerogatives, and duties as if she had been a king, and whose husband is a subject; or *queen-dowager*, widow of the king, who enjoys most of the privileges which belonged to her as queen-consort. In some countries, such as Sweden and Belgium, a woman is debarred from succession to the throne by the Salic Law. In Britain a woman succeeds to the throne when she has no brothers. See *Salic Law*.

Queen Anne's Bounty, a fund applied to the increase of the incomes of the poorer clergy of the Church of England, and to aid incumbents in rebuilding parsonages by granting advances of money, in virtue of a royal charter confirmed by 2 and 3 Anne, cap. xi. By this Act the first-fruits (the whole income of an incumbency for the first year after a new appointment) and the

tenths (a tenth of the annual income of every incumbency), which before the Reformation had been paid to the Pope, but had been annexed to the Crown by Henry VIII, were assigned to a corporation created by the Act and entrusted with the duty of administering the fund for the purpose mentioned. The livings that benefit by the bounty are all those not exceeding £50 a year. All augmentations from this fund are conditional upon an equal or larger sum being privately raised for the same purpose. It amounts now to about £70,000 per annum.

Queen Charlotte Islands, a group of islands in the North Pacific Ocean, off the mainland of British Columbia, north of Vancouver Island, discovered by Cook about 1770, and annexed to the British Crown in 1787. The northernmost of the two larger islands is called Graham Island, and the southernmost Moresby Island. The greatest length of the two together is about 160 miles, and the greatest breadth (of the northern island) about 70 miles. All the islands are covered with magnificent forests; gold-bearing quartz of rich quality has been found, and copper and iron ores and a fine vein of anthracite coal also exist. There are numerous creeks suitable for harbours. The climate is excellent. The islands form part of British Columbia.

Queens, a borough of New York City, United States, so constituted in 1898. It has an area of 100 sq. miles, and includes Long Island City, Jamaica, and Newtown, &c. Pop. 379,750.

Queensberry, William Douglas, fourth Duke of, and third Earl of March, a notorious nobleman of the eighteenth and early years of the nineteenth century, often referred to during his later years as 'Old Q'. He was born in 1724 and died in 1810, was the only son of the second Earl of March, and inherited the title of duke from a cousin in 1728. He early distinguished himself as a patron of horse-racing, in which and in connected betting he seems to have been singularly successful. He was a byword for loose living and 'gallantries', and having never married, at his death his titles and estates devolved on several heirs. In this way the third Duke of Buccleuch became fifth Duke of Queensberry, Sir Charles Douglas became Marquess of Queensberry, and the sixth Earl of Weymss became Earl of March. Queensberry was for a number of years one of the representative peers for Scotland; he afterwards sat in the House of Lords as a British peer, and he was long one of the lords of the bedchamber. He figures as Earl of March in Thackeray's *Virginians*. He came under the lash of Burns owing to his having cut down the trees about the ducal residence, Drumlanrig Castle, and a similar destruction at Neidpath Castle earned him the scorn of Wordsworth.

Queens' College, Cambridge, was founded in 1448 by Margaret of Anjou, queen of Henry VI, and again in 1465 by Elizabeth, queen of Edward IV. The name of the college is frequently misspelt *Queen's*, but it commemorates both the foundresses. The college buildings are among the most interesting in the university. John Fisher, Thomas Fuller, and Bishop Pearson were members of the college. It was the residence of Erasmus during his stay at Cambridge.

Queen's College, Oxford, was founded in 1840 by Robert Eglesfield, chaplain to Philippa, queen of Edward III, and it is from her that it gets its name. The subsequent foundations of John Michel, Sir Francis Bridgman, and Lady Margaret Hungerford were consolidated into one with that of Eglesfield in 1858. Among the members of the college have been: John Wycliffe, Edward the Black Prince, Henry V, Addison, Wycherley, and Jeremy Bentham.

Queen's County, a county of Ireland, in the province of Leinster, with an area of 664 sq. miles. The surface is generally flat, but rises in the north-west into the Slieve-Bloom Mountains (Arderin, 1734 feet). The principal river is the Barrow, which drains almost the whole county. At Portarlington the Grand Canal enters the county, and runs east and then south to Kilkenny. Anthracite coal of good quality is worked in the south. Limestone abounds, and in a few places marble is obtained. Bogs are numerous towards the centre of the

name from Queen Mary, the predecessor of Elizabeth. Pop. 54,000.

Queensferry, North, a village of Fifeshire, on the north shore of the Firth of Forth, opposite South Queensferry; served by the North British Railway. It is noted for sea-bathing, and there is a fishing industry. Pop. (1921), 1000.

Queensferry, South, a royal and municipal burgh and seaport of Linlithgowshire, Scotland, on the south side of the Firth of Forth, at a point where the latter narrows to a width of about 2 miles. Across this point is the Forth Bridge, of which South Queensferry forms the southern approach. The town is close to the naval base Rosyth, and was of considerable importance during the European War. In olden times it was the ferry-station for the North Shore and Dunfermline, &c. It was used frequently as such by Margaret, queen of Malcolm Canmore, and it is from her that Queensferry derives its name. It became a burgh of royalty in 1363, and a royal burgh in 1639. Pop. (1921), 2193.

Queensland, a state of the Australian Commonwealth, comprising the entire north-eastern region of the Australian continent and the adjacent islands of the Pacific and Gulf of Carpentaria.

Area and Population.—The following table shows the ratio which the area of Queensland bears to that of other states and territories and to the Commonwealth:—

State or Territory.	Area, sq. Miles.	New South Wales.	Victoria.	Queens- land.	South Australia.	Western Australia.	Tas- mania.	Northern Territory.	Common- wealth.
Queensland	670,500	2 167	7·620	1·000	1·764	0·687	25·577	1·280	0·225
New South Wales . .	300,432	1 000	3 521	0·461	0·814	0·317	11 804	0·591	0·104
Victoria	87,884	0·284	1·000	0·131	0·231	0·090	3·352	0·168	0·030
South Australia . .	380,070	1·228	4·325	0·567	1·000	0·389	14 498	0·726	0·128
Western Australia . .	975,920	3·154	11·105	1 456	2·568	1·000	37·228	1·864	0·328
Tasmania	26,215	0·085	0·298	0·039	0·069	0·027	1·000	0·050	0·009
Northern Territory . .	523,620	1·692	5·958	0·781	1·378	0·537	19 974	1·000	0·176
Federal Territory . .	940	0·003	0·011	0·001	0·002	0·001	0·036	0·002	0·000 ¹
Commonwealth . .	2,974,581	9·613	33·847	4·436	7 826	3 048	113·469	5·681	1·000

¹ The correct decimal is 0·0003.

Note.—As will be seen from the top line, Queensland is more than double the size of New South Wales, or seven times larger than Victoria, and about twenty-five and a half times bigger than Tasmania, but it only represents roughly a quarter of the total area of the Commonwealth. From the bottom line, the Commonwealth is seen to be nine and a half times larger than New South Wales, four and a half times larger than Queensland, and a hundred and thirteen times larger than Tasmania.

county. Agriculture is not generally in an improving state, drainage in particular being much wanted. The principal crops are oats, barley, and root-crops. Many cattle are reared. Maryborough is the county town, and Mountmellick, a market town on a branch of the Grand Canal, is the only other one of importance. Like the county itself, it derives its

The pop. (1921) is 757,634. In 1846 it was only 2257.

Towns.—Brisbane is the capital, and has a population (1921) of 209,699. Other towns are: Ipswich (25,000); Toowoomba (24,000); Rockhampton (20,000); Charters Towers (17,300); Townsville, the capital of Northern Queensland (18,900); Gympie (12,400); and Maryborough (11,700).

Physiography.—Queensland has a coast-line of 8000 miles, i.e. there are 238 sq. miles of territory to every mile of coast-line. Off the coast, and running parallel to the land for over 1000 miles, is the Great Barrier Reef, of coralline structure, which forms a natural mole or breakwater, enclosing a lagoon-like belt of calm water. Opposite the discharge of large rivers, however, there are gaps in the reef, caused by the peculiar conditions existing at these points, under which the coral-forming animalculæ will not perform their work. Where the Great Dividing Range enters the state it branches off to the north-west, with numerous extensions northwards and southwards, the main range forming a plateau of 1500 to 2000 feet altitude, which runs from north to south at from 20 to 100 miles from the coast. There is also a low coastal range. The principal rivers are the Brisbane, Burnett, Fitzroy, and Burdekin, flowing to the Pacific; and the Gilbert, Flinders, Mitchell, and Leichardt, draining to the Gulf of Carpentaria. **Climate.**—Slightly more than half the area of Queensland lies within the tropics, and the climate, therefore, is warm, but it is so modified by ocean breezes that the daily range is less than that of other countries under the same isotherms. Generally the coastal plain is much warmer than the elevated plateau of the hinterland,

Communications.—In 1919-20 there were 5979 miles of railway of 3-feet-6-inch gauge, 27 miles of 2-feet-6-inch gauge, and 942 miles of 2-feet-0-inch gauge, a total of 6947 miles, representing only 8·89 miles of line per 1000 sq. miles of territory (or 8·09 miles per 1000 inhabitants). Most of the 3-feet-6-inch gauge lines are State owned and operated. There are no Federal railways within the state. All the Queensland railways may be said to radiate from Brisbane. A coastal line runs north, and from it feeders are sent out into the hinterland. Another trunk line runs west, and a complicated network of railways serves the south-west and southern suburbs and adjacent districts of Brisbane.

Production: Agriculture.—The principal crops are wheat and maize; sweet-potatoes, sugarcane, cotton, fruit, hay, green fodder, and ensilage; barley and some oats, tobacco, coffee, arrowroot, and potatoes are also raised. **Irrigation.**—The principal irrigation works are: (a) those at Ayr, utilizing the waters of the Burdekin River and the shallow wells on its banks; (b) those at Bingera, near Bundaberg, utilizing water pumped from the Burnett River just above the meeting-point of the salt and fresh waters; and (c) those at Fairymead, utilizing water pumped from a number of shallow spearwells sunk on the alluvial flats, on the north

Areas.	Queensland, sq. Miles.	Western Australia, sq. Miles.	Northern Territory, sq. Miles.	Total, sq. Miles.
Within Tropical Zone	359,000	364,000	426,320	1,149,320
Within Temperate Zone	311,500	611,920	97,300	1,020,720
Ratio of tropical part to whole state	0·535	0·373	0·814	0·530
Ratio of temperate part to whole state	0·465	0·627	0·186	0·470

but in such a large territory climate varies with the place. The accompanying table illustrates tropical Queensland in its relation to the other tropical states of the Commonwealth. **Rainfall.**—The wettest known part of Australia is on the north-east coast of Queensland, between Port Douglas and Cardwell, where three stations, situated on or adjacent to the Johnstone and Russell Rivers, have an average rainfall of between 148 and 166 inches, although 200 inches have frequently been recorded. In Queensland, as in the Northern Territory, the heaviest rains fall during the summer months, but good averages are maintained during the other seasons. Occasionally, also, the north-east coast is visited by hurricanes from the north-east tropics, which seem to have their origin in the South Pacific Islands, their path being a parabolic curve of south-westerly direction. Only a small percentage, however, reach Australia, the majority recurving in their path to the east of New Caledonia.

¹ **Artesian Basins.**—Queensland lies within the principal artesian basin of the Australian continent, viz. the Great Australian Basin, which has an area of 569,000 sq. miles, 376,000 sq. miles being in Queensland. Practically the whole of the state lying west of the Great Dividing Range, with the exception of an area in the north-west contiguous to the Northern Territory, is included in the Basin, which is said to be the largest yet discovered. The estimated yield of water from 1236 flowing bores on 30th June, 1920, was 318,300,000 gallons per diem. The deepest well has a depth of 6938 feet, and yields approximately 107,300 gallons daily. The waters of many of the wells have been analysed, and some found suitable for wool-scouring only; others are suitable for watering stock but not for irrigation, owing to the presence of alkali; others, again, serve for both stock and irrigation, while some, such as those containing sulphuretted hydrogen, are not of any use. Water fit for stock may generally be said to be 'safe' for domestic purposes in spite of its slightly mineral taste. Wells yielding waters known as 'Helidon Spa', 'Boonah Spa', and 'Junot Spa', much used in Queensland and New South Wales, are shallow wells of from 60 to 200 feet in depth.—Cf. Professor J. W. Gregory, *The Dead Heart of Australia; The Flowing Wells of Central Australia* (in *Geographical Journal*, July and August, 1911). Also see E. F. Pittman, A.R.S.M., *Problems of the Artesian Water-supply of Australia, with special reference to Professor Gregory's Theory* (Clarke Memorial Lecture, Oct., 1907); *The Great Australian Artesian Basin; The Composition and Porosity of the Intake Beds of the Great Australian Artesian Basin*.

side of the Burnett River and about 6 miles from Bundaberg. There were (1919) 701 irrigators in the state, principally farmers and graziers, the irrigated area covering 9267 acres. *Forests*.—There are forest reservations of (1920) 3,948,000 acres. Among trees of importance are eucalypti, pine, and cedar. *Fisheries*.—The Great Barrier Reef littoral is the haunt of a myriad of gorgeously coloured fishes, and sharks and enormous perches are numerous. Oysters are abundant; turtle is found in the north; and the pearl-fishery of Torres Strait is both extensive and lucrative, especially around Thursday Island. Trepan, cowries, and clam-shell are also fished, together with many other common and uncommon fish. *Minerals*.—Coal is mined, and gold has been worked since 1858. Silver, copper, tin, wolfram, lead, limestone, and fire-clay are also worked.

Religion.—There is no State Church, and the Anglicans predominate, with Roman Catholics second, and Presbyterians third.

Education.—Elementary education is free and compulsory, and secondary education is provided for. There are Government scholarships, tenable for three years in the 10 grammar schools of the state. Queensland University (founded 1911) is located at Brisbane, and had 406 students in 1920. There are 17 technical schools with (1920) 11,860 students.

Government.—There is a Governor, who appoints a Lieutenant-Governor, and there is an Executive Council, the responsible ministry. Parliament consists of two Houses, a Legislative Council (59 members nominated by the Crown for life) and a Legislative Assembly of 72 members, who are returned by 72 electoral districts and sit for three years. Suffrage is universal (adult male and female), one year's continuous residence within the state being the modifying condition. Until 1859, when it was erected into a separate colony, Queensland formed a part of New South Wales.

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Queen's - Pigeon, a magnificent ground-pigeon, inhabiting the islands of the Indian Ocean, named after Queen Victoria. It is one of seven species constituting the genus *Goura* (*G. victoria*), and is the largest and most beautiful member of the order.

Queenstown or Cobh (formerly Cove of Cork), an urban district and seaport of County Cork, Ireland, on the south side of Great Island, which rises abruptly out of Cork harbour;

served by the Great Southern & Western Railway. Queenstown is a naval station, and is defended by fortifications on Spike Island and at the entrance of the harbour. It is the port for the transmission of American mails, and a chief emigration station. It has little trade and no manufactures. Queen Victoria visited the town in 1849, when its name was changed from Cove of Cork to Queenstown, and the name Cobh was taken into general use on the erection of the Irish Free State. Pop. 8000.

Querétaro (ke-rā'tā-rō), a central state of Mexico, forming part of the central plateau. It is exceedingly mountainous and semi-arid in the north, but the valleys of the south and west produce cereals, fruit, and cotton. Opals are mined. The capital is Querétaro. Area, 4493 sq. miles; pop. (estimated, 1912), 250,000.

Querétaro, a city of Mexico, capital of the state of Querétaro, on a plateau 6000 feet above sea-level, 110 miles north-west of Mexico. It is served by the national railways. An aqueduct about 2 miles long, with seventy-four arches each 90 feet high, and a tunnel in the opposite hills bring a copious supply of water to Querétaro from a distance of 6 miles. Pop. 30,000.

Quern, a hand-mill for grinding corn, such as is or has been in general use among various



Grinding Corn with a Quern

primitive peoples. The simplest and most primitive form of the quern is that in which a large stone with a cavity in the upper surface is used to contain the corn, which is pounded rather than ground with a small stone. The most usual form consists of two circular flat stones, the upper one pierced in the centre, and revolving on a wooden or metal pin inserted in the lower. In using the quern the grain is dropped with one hand into the central opening, while

with the other the upper stone is revolved by means of a stick inserted in a small opening near the edge. Hand-mills of this description are used in parts of Scotland and Ireland to the present day.

Quesnay (kă-nă), François, French economist and physician, born in 1694, died in 1774. He was appointed surgeon in ordinary to the king, and subsequently, having taken the degree of M.D., physician to Madame de Pompadour, the mistress of Louis XV, who afterwards had him appointed physician to the king. He is best known, however, as an economist. In 1756 he published the articles on *Fermiers* and *Grains* in the *Encyclopédie*, and advanced the doctrine of *produit net*, i.e. that the surplus of agriculture is the sole source of national wealth. His *Tableau économique* appeared in 1758, but disappeared and was only discovered in 1890. Quesnay's disciples formed the school known as the Physiocrats. See *Physiocratic System*.—Cf. H. Higgs, *The Physiocrats*.

Quesnel (kă-nel), Pasquier (Paschasius), French theologian and moralist, born at Paris in 1634, died at Amsterdam 1719. He became a member of the order of the Fathers of the Oratory in 1657, at that time a great nursery of Jansenism, and in 1671 wrote his *Réflexions morales sur le Nouveau Testament*, consisting of thoughts on some of the most beautiful maxims of the evangelists. This work brought him under suspicion of the Church on account of its Jansenistic tendencies, and he had (1685) to quit French territory. Going to Brussels, he there applied himself to the continuation of his work on the New Testament, which was published entire in 1693-4. In this some leading points in Roman Catholicism were freely questioned. Bossuet and Noailles, Archbishop of Paris, rather approved of the book; but the Jesuits obtained from Pope Clement XI a Bull condemning 101 of Quesnel's propositions as heretical. This Bull, the notorious *Unigenitus* (promulgated in 1713), not only stirred up the Jansenists (q.v.), but awoke bitter dissensions in the bosom of the Gallican Church. Meantime Quesnel had been compelled to seek refuge (1703) in Holland, where he resided for the rest of his life.—Cf. L. Séché, *Les Derniers Jansénistes*.

Quételet (kât-lă), Lambert Adolphe Jacques, Belgian statistician and astronomer, born at Ghent in 1796, died in 1874. He studied at the lyceum of his native town, where, in 1814, he became professor of mathematics. In 1819 he was appointed to the same chair in the Brussels Athenæum. In 1828 he became lecturer in the Museum of Science and Literature, holding the post till 1834, when the institution was merged in the newly established university. Quételet

superintended the erection of the Royal Observatory, and became its first director (1828). A member of the Belgian Royal Academy, he became its perpetual secretary in 1834. Quételet's writings on statistics and kindred subjects are very numerous. He also published many papers on meteorology, astronomy, and terrestrial magnetism. His works include: *Physique populaire de la chaleur*, *Histoire des sciences mathématiques et physiques chez les Belges*, and *Anthropométrie*.

Quetta, the capital of Baluchistan, in a plain 5500 feet above sea-level, among lofty mountains. It is of great strategical importance as commanding the northern entrance of the Bolan Pass. A railway from Shikarpur, on the Indus, traverses the pass to Quetta and beyond towards Kandahar, 125 miles distant. By a treaty with the Khan of Khelat, in 1876, a British protectorate was established, and the district now forms part of British India. The town contains a British garrison and the Indian staff college, and there are extensive magazines of war material. Pop. 33,000.

Quetta-Pishin, a highland district of Baluchistan, India, comprising a series of valleys of some length and medium width, forming the catchment area of the Pishin Lora, and enclosed on all sides by the mountains of the Toba-Kakar and Central Brahui ranges. The railway from Quetta to Chaman traverses the district. About 80 per cent of the people are Pushtu-speaking Mahommedans of the Sunnite sect, and 6 per cent are Brahui. Quetta is the capital. Area, 5200 sq. miles; pop 120,000.

Quetzalcoatl, an Aztec god, one of the principal gods in Mexican mythology, whose name meant *plumed serpent*. He was looked upon as the patron of works of art, and is said to have reigned at the ancient city of Tula. He taught his subjects agriculture and metal-work, preached universal brotherhood, and during his reign there was peace and happiness. His rival, however, Tezcatlipoca, forced him to leave the country, and Quetzalcoatl went, promising his people to return. When Cortez landed in Mexico, in 1519, the Aztecs, remembering the legend, believed that it was Quetzalcoatl returned to Tula.

Quezal, a most beautiful Central American bird of the Trogon family (*Pharomacrus mocinno*). It is about the size of a magpie, and the male is adorned with tail-feathers from 3 to 3½ feet in length, and of a gorgeous emerald colour. These feathers are not strictly speaking the true tail-feathers (the colour of which is black and white), but are the upper tail coverts of the bird. The back, head (including the curious rounded and compressed crest), throat, and chest are of the same rich hue, the lower parts being of a brilliant

scarlet. The female wants these long feathers, and is otherwise much plainer. The food of the quezal consists chiefly of fruits. It lives in forests of tall trees. There are several allied



Quezals (*Pharomacrus mocino*)

species of birds, but none with the distinctive feature of the quezal.

Quezaltenan'go, a maritime department and town of Guatemala, Central America. The department lies along the Pacific Ocean, and is mountainous, containing Santa Maria (12,350 feet altitude), an active volcano. Rubber, sugar, coffee, cereals, and live-stock are produced. The capital is Quezaltenango, standing on a plateau at an altitude of 7750 feet. It is the second city of Guatemala, and trades in agricultural produce. There are manufactures of cotton and linen. Pop. (department), 120,000; (town), 29,000.

Quiberon (kēb-rōn), a peninsula, a bay, and a town of Morbihan, France. Here in 1759 Admiral Hawke gained a great victory over a French fleet. In 1795 a body of French royalists was landed here by an English fleet, but was speedily cut off by General Hoche.

Quichua (kē'chū-á), the name of a native race

of South America, inhabiting Peru, parts of Ecuador, and Bolivia. The name is supposed to signify those who speak correctly, as distinguished from tribes of alien stock. With the Aymaras the Quichuas composed the larger portion of the population of the empire of the Incas. They absorbed the earlier cultures of Peru, those of the Aymara and Yunca tribes. The Quichua language, which was formerly the State language of the Incas, is still the chief speech of Peru, of a large portion of Bolivia, of the part of Ecuador bordering upon Peru, and of the northern section of the Argentine Republic. It is one of the most beautiful and at the same time comprehensive tongues of America.—Cf. W. H. Prescott, *History of the Conquest of Peru*.

Qui'tism (Lat. *quies*, rest), a form of mysticism which aims at the elevation of man to a state of pure contemplation of the Divinity. It maintains that man's highest perfection, which consists in psychical self-annihilation and most perfect communion with God, can be attained only in a state of quietude. The soul, ceasing to reflect either upon God or itself, ceasing to will and to think, remains in a passively receptive attitude, accepting the fellowship of God, acting within it. Quietism thus emphasizes suppression of conscious will, and attaches little importance to activity of religion. Quietism is a characteristic feature of Hindu philosophy and religion, of Brahmanism and Buddhism, as well as of Alexandrian Neo-Platonism and of Christian mysticism. Quietistic ideas are found in the doctrines of the Beghards (twelfth century), of the followers of Master Eckhart (thirteenth and fourteenth centuries), of the Brethren of the Free Spirit, of the Illuminati, and especially in the teaching of the Quakers. The term *quietism* is, however, particularly applied to a mystical movement which arose in the Catholic Church in the seventeenth century. This movement, which swept over Europe at the close of the seventeenth and the beginning of the eighteenth centuries owed its origin to such works as *The Spiritual Guide* of Molinos, in which the devout were taught, by contemplation, to bring the soul into direct union with the Godhead, and so receive the infused heavenly light. The most noted promoter of quietism in France was Madame Guyon. Fénelon became the advocate of Madame Guyon and her writings in his *Explication des maximes des Saints sur la vie intérieure* (1697). Bossuet obtained (1699) a Papal brief, which condemned twenty-three positions from Fénelon's book as erroneous; but the humility with which the latter submitted deprived his enemies of the fruits of their victory; and it was the change in the spirit of the times and not violence that gradually buried quietism in oblivion.—BIBLIOGRAPHY: W. R. Inge, *Chris-*

tian Mysticism; W. James, *The Varieties of Religious Experience*; J. Bigelow, *Molinos, the Quietist*; E. Murisier, *Les Maladies du sentiment religieux*.

Quillmane (kil-i-mä'ne), a seaport-town of Portuguese East Africa, unhealthily situated about 15 miles above the mouth of a river of the same name (the northern branch of the Zambezi). The harbour is good, but trade is undeveloped. Pop. 2000 (500 Europeans).

Quillai-bark (*Quillaia Saponaria*), the bark of a South American tree belonging to the wing-seeded section of the Rosaceæ. It is used to make a lather instead of soap in washing silks, woollens, &c. It is called also *Quillaya-bark*.

Quiller-Couch, Sir Arthur Thomas, British author and critic, was born at Fowey, Cornwall, in 1863. He was educated at Clifton and at Trinity College, Oxford, where he took a first class in classical moderations in 1884, and a second in the final classical examination in 1886. From 1886 to 1887 he was a lecturer in classics in his college. He then commenced his career as author with *Dead Man's Rock*, an improbable but thrilling story which became very popular. He followed up his success with a great number of books, all distinguished by good style and good taste, and many by a keen sense of humour. Among them may be mentioned: *Troy Town* (1888), *I saw Three Ships* (1892), *The Ship of Stars* (1899), *Fort Amity* (1904), *Major Vigoureux* (1907), *Corporal Sam* (1910), and *Foe-Farrell* (1918). In 1897 he was commissioned to finish Stevenson's novel *St. Ives*, and he performed this difficult and delicate task with much skill. In 1912 he was appointed to succeed A. W. Verrall as King Edward VII professor of English literature at Cambridge. He has since published some of his lectures: *On the Art of Writing* (1916), *Shakespeare's Workmanship* (1918), and *On the Art of Reading* (1920). As a critic he is always sound and often entertaining; he is a sworn foe to pedantry, and does not believe in allowing literature to be subordinate to philology. He has edited some well-chosen anthologies: *The Oxford Book of English Verse* (1900), *The Oxford Book of Ballads* (1910), and *The Oxford Book of Victorian Verse* (1912). He was knighted in 1910.

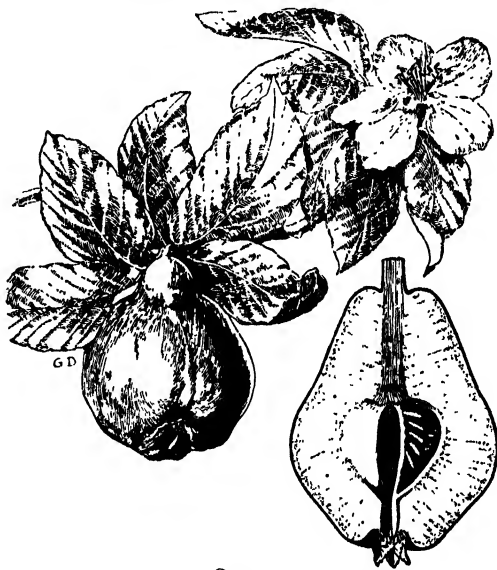
Quillota (kil-yō'ta), a town of Chile, in the province of Valparaiso, 23 miles north-east of Valparaiso. The copper-mines in the vicinity are regarded as the richest in Chile. Pop. 15,000.

Quimper (kan-pär), a town and port of Brittany, France, capital of the department of Finistère, at the head of the estuary of the Odet, an old town partly surrounded by walls flanked by towers. The principal buildings are: the Gothic cathedral of St. Corentin (1239-1515); the ruins of a Cordelier church and

cloister; the college, the prefecture, and the military hospital. The manufactures are earthenware, leather, and cordage. The sardine-fishery forms an important occupation. Pop. 22,000.

Quin, James, British actor, of Irish parentage, born in London in 1698, died at Bath 1766. He made his first appearance on the stage at Dublin in 1714; shortly afterwards he obtained an engagement in London, and gradually acquired celebrity as a tragic actor as well as in characters of comic and sarcastic humour, like Falstaff, Volpone, &c. He retained his pre-eminence until the appearance of Garrick in 1741. His last performance was as Falstaff (1753), in which character he is supposed never to have been excelled.

Quince, the fruit of the *Cydonia vulgaris*, nat. ord. Rosaceæ. The quince tree, which is



Quince
Section of fruit at right

supposed to be a native of Western Asia, is cultivated in Europe and the United States for its handsome golden-yellow fruit, which, though hard and sour when plucked from the tree, becomes excellent when boiled and eaten with sugar, or preserved in syrup, or made into marmalade. Other species are the Chinese quinces (*C. sinensis* and *cathayensis*) and the Japanese quince (*C. japonica*).

Quincy, a city of Illinois, United States, the county seat of Adams county, on the Mississippi; served by the Chicago, Burlington, & Quincy, the Wabash, and the Quincy, Omaha, & Kansas City Railways, and by river-steamers. It was settled in 1821, and became a city in 1839.

There are extensive and varied manufactures. Pop. (1920), 35,980.

Quincy, a city of Massachusetts, United States, in Norfolk county, on Massachusetts Bay; served by the New York, New Haven, & Hartford Railway, and by an electric-traction line (local). Boston is just across the Neponset River from Quincy, which is therefore more or less a suburban residential area of the adjacent city. It was settled in 1625, and became a city in 1888, the name being changed from Mount Wollaston in 1792. Pop. (1920), 47,880.

Quinet (kē-nā), Edgar, French philosopher, poet, historian, and politician, born 1803, died 1875. He first attracted attention by a translation of Herder's *Philosophie der Geschichte* in 1825. In 1828 he accompanied a scientific commission to the Morea; and in 1839 he became professor of foreign literature at Lyons, a position he changed in 1841 for a similar chair in the Collège de France. His works, which number about thirty volumes, include poems, dramas, histories, and religious mystical books.

Quin'ine, ($C_{20}H_{24}N_2O_2 \cdot 3H_2O$), a diacid base derived from quinoline, of intensely bitter taste and strong alkaline reaction. Quinine is the best known and most widely used of the alkaloids obtained from the barks of the various species of cinchona (q.v.). Cinchona bark, which was originally found in South America, was introduced into medicine by the Spaniards about 1635; but it was not till the beginning of the nineteenth century that quinine was used, and it has since then entirely taken the place of cinchona. Quinine is used in malaria, and its efficacy in that disease is marked. It is one of the best examples of the specific action of a drug in therapeutics, as it causes the malarial organism found in the blood to break up and disappear. Quinine, in small doses, is a stomachic, and is therefore given to aid digestion and improve the appetite. It was also at one time widely used on account of its antipyretic effect; but now, when such effect is desired, other more certain drugs, as phenacetin, acetanilide, or phenazone, are used.

Quinoa (kwi-nō'a), a South American plant (*Chenopodium Quinoa*), of which there are two cultivated varieties, one yielding white seeds, and sometimes called petty-rice, the other red. The white seeds are extensively used in Chile and Peru as an article of food in the form of porridge, cakes, &c. The seeds of the other variety, *red quinoa*, are used medicinally as an application for sores and bruises.

Quinoline, an organic compound (C_8H_7N) which occurs, along with derivatives, in coal-tar (q.v.), and may be prepared from aniline. It is a colourless strongly refracting liquid with

a very characteristic odour, and has antiseptic and antipyretic properties. See *Quinine*; *Ring in Chemistry*.

Quinsy is an abscess which arises in the tissues surrounding the tonsil. It usually follows an acute tonsillitis, and the infection spreads from the tonsil to the parts around, where in the course of a few days an abscess is formed. Quinsy occurs most commonly where there is a septic condition of the mouth, gums, nose, or where the tonsils are enlarged and septic. There is extensive swelling of the affected side, usually involving the palate and uvula, with pain, inability to swallow or to open the mouth properly, alteration of the voice, rise of temperature, and general *malaise*. When abscess-formation takes place, the only satisfactory treatment is to open the abscess, and this is followed by a rapid lessening of the symptoms. Mouth-washes should be used freely, both before and after the incision, and tonics should be administered for the patient's general condition. After an attack any septic focus in the mouth should be dealt with, and if the tonsils are septic they should be removed.

Quintain, a figure or other object set up to be tilted at with a lance. It was constructed in various ways; a common form in England consisted of an upright post, on the top of which was a horizontal bar turning on a pivot; to one end of this a sand-bag was attached, on the other a broad board; and it was a trial of skill to tilt at the broad end with a lance, and pass on before the bag of sand could whirl round and strike the tilter on the back.

Quintet, a composition for five instruments or five voices. Quintets are much less common in music than quartets, and the choice of instruments is more subject to variation. In the case of string quintets the usual combination is two violins, two violas, and 'cello. Many composers, especially in more recent times, have written for pianoforte, two violins, viola, and 'cello, the works in this class by Schumann, Brahms, and César Franck being among the masterpieces of music. Mozart wrote a quintet for piano and wind-instruments, and another for clarinet and strings, both being among his finest works. The most beautiful example in modern music of a vocal quintet occurs in the first scene of the third act of Wagner's *Meistersinger*.

Quintil'ian (Marcus Fabius Quintilianus), Roman rhetorician, was born at Calagurris, Spain, between A.D. 30 and 40. He is one of the many notable literary men who were produced during the century in that thoroughly Romanized province. Where his early education was carried out is uncertain, but it is clear that he was trained according to the recognized principles of the time, i.e. under 'grammatici', who

taught him literature, grammar, and easy composition; and afterwards under 'rhetores', who drilled him in composition, written or oral, of a higher kind, and taught him the principles of 'rhetoric' as then accepted. On the methods employed by his teachers he has left us a few notes. Later on he attached himself at Rome to the leading orator of the day, Domitius Afer, and by following him through the courts acquired practical experience. He then appears to have returned to Spain, and very possibly set up there as a 'rhetor', or teacher of rhetoric. In 68 he returned to Rome with Galba, who for a short time occupied the imperial throne after Nero's death. At Rome Quintilian established himself as the head of the teaching profession, and is addressed by Martial as the "chief controller of restless youth". He also gained great reputation as a pleader in the law courts. In his capacity as teacher he was a recipient of the Treasury grant to rhetores instituted by Vespasian, and this, in addition to the fees he charged his pupils, seems to have brought him to a degree of affluence unusual in his profession. He was also granted the 'insignia' of a consul, an unprecedented honour for a rhetor. He retired somewhere about A.D. 90. The date of his death is unknown.

Quintilian's fame rests on his work entitled *De Institutione Oratoria* (How to Train an Orator) in twelve books, which he composed not very long after his retirement and published some time before the death of Domitian, which occurred in A.D. 96. There are also two collections of declamations attributed to him. These have in their time enjoyed considerable popularity, but one is certainly and the other probably spurious, and neither has any of the value which belongs to the *De Institutione Oratoria*. This last is one of the most remarkable monuments of Roman good sense, and teems with noteworthy remarks on oratory, literary criticism, and above all education. It professes to train the public speaker, and thus begins with the writer's views as to what constitutes the best education from the cradle upwards. This part of the work, which covers the first book and half the second, is of extraordinary interest, and during the Middle Ages and after the Renaissance was more studied than any other book on the subject, though few ventured to follow the writer in the best known of his precepts—the non-use of the *rodi*. He then proceeds to discuss the laws of 'rhetoric', or the 'art of effective speech', under its main heads of subject-matter (*inventio*), arrangement, expression (*elocutio*), memory, and delivery (*pronuntiatio*). Though we have ceased to believe in an 'art of rhetoric' as the true means of acquiring a command of language, there is so much

sense amidst all the technicalities of Quintilian's handling that it has by no means lost its value. In the early part of the tenth book, having observed that the reading of good authors is indispensable for the acquisition of a good style, he proceeds to give a brief sketch of the most notable Greek and Latin authors, and their merits. This chapter is the best-known piece of literary criticism that has come down to us from antiquity.

Up to something like a century or so ago Quintilian was one of the most highly esteemed of classical writers. For instance, Jerome in the fourth century, John of Salisbury in the twelfth, Erasmus in the sixteenth, Ben Jonson in the seventeenth, and Pope in the eighteenth bear strong marks of his influence. It may be noted that from the ninth to the fifteenth centuries Quintilian was mainly known in a mutilated version, which contains about three-fifths of the work, and the zenith of his reputation dates from the discovery of the complete text by Poggio in 1413. During the last century his reputation has suffered an eclipse, partly perhaps through the discredit that has gathered round the name of rhetoric; yet there are still many who agree with Mill, who, in his *Autobiography*, after remarking that Quintilian is seldom sufficiently appreciated, goes on: "His book is a sort of encyclopedia of the thoughts of the ancients on the whole field of education and culture, and I have retained through life many valuable ideas which I can distinctly trace to my reading of him, even at that early age."

Quintus Cal'aber, or Smyrnæus, Greek poet, author of a sort of continuation of the *Iliad* (*Posthomericæ*) in fourteen books, a rather dull imitation of Homer. He probably flourished at Smyrna in the fourth century A.D. The only manuscript of his work having been discovered at Otranto, in Calabria, he is called Calaber from this fact.

Quirinal, one of the seven hills of ancient Rome. There is a palace there, begun in 1574 by Gregory XIII, and formerly a summer residence of the Popes, but since 1871 the residence of the King of Italy. See *Rome*.

Quirinus, among the Romans, a surname of Romulus after he had been raised to the rank of a divinity. Hence *Quirinalia*, a festival in honour of Romulus, held annually on the thirteenth day before the Kalends of March, that is, the 17th of February. Quirinus is the third great god, ranking next to Jupiter and Mars.

Quirites (from the Sabine *quiris*, a spear), a designation of the citizens of ancient Rome as in their civil capacity. The name of Quirites belonged to them in addition to that of *Romani*, the latter designation applying to them in their political and military capacity.

Quito (kē'tō), the capital of Ecuador and of the province of Pichincha, and the seat of the Archbishop of Ecuador. It stands in a ravine on the east side of the volcano of Pichincha, 9848 feet above the sea, a little to the south of the equator. Its streets, with exception of four which meet in the large central square, are narrow, uneven, badly paved, and extremely dirty. The more important public buildings are the cathedral, several other churches and convents; the town house, court-house, president's palace, the Central University (with faculties of medicine, science, pharmacy, and jurisprudence), the archiepiscopal palace, orphan asylum, and hospital. The manufactures consist chiefly of woollen and cotton goods. From the want of good roads and railways trade is much hampered. Quito was originally the capital of a native Indian kingdom of the same name, but was taken successively by the Incas (1470) and by the Spaniards (1534). It has repeatedly suffered from earthquakes. Pop. 70,000.

Quit-rent, in law, a small rent payable by the tenants of most manors, whereby the tenant goes quit and free from all other services.

Quoad Sacra Parish (i.e. a parish 'so far as regards sacred matters'), in Scotland, is a district that forms a parish only so far as purely ecclesiastical matters are concerned, having a church and minister of its own (belonging to the Established Church).

Quoits, a British pastime of considerable antiquity, particularly popular in the Midlands, Lancashire, and Scotland, seems directly descended from the Greek and Roman sport of 'throwing the *discus*'. The mode of play resembles that employed in bowls, the quoit, however, being thrown in the air. This quoit

is an iron ring, nearly flat, about 6 lb. in weight, and not exceeding 8½ inches in diameter. The upper side is slightly convex, and on its outer rim there is a niche or dent, gripped by one finger in the act of throwing. Two pins, the 'hobs', placed about 18 yards apart, project an inch or so above the circles of damp clay, called 'ends', in which they stand. The aim of the players, who may be either one or two upon each side, is to throw the quoit so that it lodges in the clay as near the 'hob' as possible; experts will often 'ring' the 'hob', such 'ringer' counting two points towards the score. A quoit, other than a 'ringer', lying nearer to the 'hob' than that of an opposing player counts one point. It is, as in the game of bowls, permissible to dislodge from its position an opponent's quoit. 'Deck quoits', played with rings of rope, is a popular amusement with ships' passengers.

Quorum, a term used in commissions, of which the origin is the Latin expression *quorum unum A. B. esse volumus* ('of whom we will that A. B. be one'), signifying originally certain individuals, without whom the others could not proceed in the business. In legislative and similar assemblies a quorum is such a number of members as is competent to transact business. The quorum in the British House of Lords is thirty, whilst in the House of Commons it is forty.

Quo Warranto, in English law, a writ formerly issued from the Court of King's Bench calling upon a person, or body of persons, to show by what warrant ('quo warranto') they exercised any public office or privilege. The writ itself is fallen into disuse, but the same end is attained by the Attorney-General filing an information in the nature of *quo warranto*.

R

R is the eighteenth letter of the English alphabet, classed as a liquid and semi-vowel. In the pronunciation of Englishmen generally it represents two somewhat different sounds. The one is heard at the beginning of words and syllables, and when it is preceded by a consonant; the other, less decidedly consonantal, is heard at the end of words and syllables, and when it is followed by a consonant. In the pronunciation of many English speakers, *r*, followed by a consonant at the end of a syllable, is scarcely heard as a separate sound, having merely the effect of lengthening the preceding vowel; when it is itself final, as in *bear*, *door*, *their*, &c., it becomes a vowel rather than a consonant.—*The three Rs*, a humorous and familiar designation for *Reading*, *Writing*, and

Arithmetic. It originated with Sir William Curtis (1752–1829), who, on being asked to give a toast, said, "I will give you *the three Rs*, *Writing Reading*, and *Arithmetic*".

Ra (more properly *Rê*), the name of the sun-god among the ancient Egyptians. In the course of time nearly all the Egyptian divinities were identified with Ra, and Amenophis IV of the eighteenth dynasty tried to establish a monotheism based upon the worship of Ra, under the name of Aton. Like Horus, Ra is represented with the head of a hawk, and bearing the disk of the sun on his head.

Raab (rüb), or Györ (dyeur) (Rom. *Arrabona*), a city of Hungary, at the confluence of the Raab and Rabnitz with the Danube. It is the see of a Roman Catholic bishop, and has

a fine cathedral (rebuilt 1639-45), an episcopal palace, and diocesan seminary. Its manufactures are machinery, agricultural implements, and oil. Pop. 43,000.

Raasay, or **Rasay**, an island of Scotland, one of the Inner Hebrides, between Skye and the mainland, included in Inverness-shire, 18 miles long and $3\frac{1}{2}$ miles broad at the widest part. It is for the most part a hilly ridge, rising in parts to over 1000 feet. There are some scattered farms on the east side of the island. The ruins of Brochel Castle are on the east coast. Pop. 300.

Rabat, a seaport and the administrative capital of the French Zone of Morocco, at the mouth of the Bou-Regreg, facing Salé (Sallee), formerly the chief port of entry for European commerce. The present maximum working capacity of the port is 300 tons per diem, and an entrance channel across the bar and up the river will give a depth of 3 metres at lowest tides. Oil, wool, and cereals are exported, and some carpets and leather shoes are made. Pop. 30,000. Rabat is a stopping-place on the State-subsidized aerial mail and passenger service, established in 1919, between Toulouse (France) and Rabat, and extended to Casablanca in 1922. There are from four to five flights a week, bringing Paris within forty-eight hours of Casablanca.

Rabbi, a title of honour among the Hebrews. There are two other forms of the title, *rabbani* and *rabbani*, the former of which is found in the New Testament. It is supposed that this title first came into use at the period immediately preceding the birth of Christ. In the time of our Lord it was applied generally to all religious teachers, and hence sometimes to Christ himself. Now the term *rabbi* or *rabbini* is applied to ministers and regularly appointed teachers of Talmudic Judaism.

Rabbinic Hebrew, that form of Hebrew in which the Jewish scholars and theologians of the Middle Ages composed their works. Grammatically it differs but little from the ancient Hebrew, but in many cases new meanings are attached to Hebrew words already in use, in other cases new derivatives are formed from old Hebrew roots, and many words are borrowed from the Arabic.

Rabbit (*Lepus cuniculus*), a genus of rodent mammals, included in the family Leporidae, to which also belong the hares. It is of smaller size than the hare, and has shorter ears and hind-legs. The rabbit's fur in its native state is of a nearly uniform brown colour, whilst under domestication the colour may become pure white, pure black, piebald, grey, and other hues. The texture of the fur also changes under domestication. The rabbit is a native of South-Western Europe and North-Western Africa, and

in its wild state congregates in 'warrens' in sandy pastures and on dry slopes. Rabbits breed six or seven times a year, and produce from five to seven or eight at a birth, being so prolific that they may easily become a pest, as in Australia and New Zealand, where it seems impossible to keep them down. They feed on tender grass and herbage, and sometimes do great damage to young trees by stripping them of their bark. They grow exceedingly tame under domestication, and there are about fourteen breeds, of which the Belgian and Flemish are the best for table purposes. Immense numbers of rabbits are exported from the Australian colonies to this country, preserved by cold storage, the skins also being exported. The skins are of considerable value; cleared of hair, they are used with others to make glue and size. The fur is employed in the manufacture of hats, and to imitate other and more valuable furs, as ermine.

Rabelais (râb-lâ), François, French humorist, born at Chinon, in Touraine, about 1490, died in 1553. The son of an apothecary, he entered the Franciscan order at Fontenay-le-Comte, in Poitou, and received the priesthood. His addiction to profane studies appears to have given offence to his monastic brethren, and through the influence of friends he obtained the permission of Clement VII to enter the Benedictine order (about 1524). He then exchanged the seclusion of the monastery for the comparative freedom of the residence of the Bishop of Maillezais, who made him his secretary and companion. In the course of a few years we find him at Montpellier, where he studied medicine, having by this time become a secular priest; he was admitted bachelor in 1530, and for some time successfully practised and taught. In 1532 he went to Lyons, where he published a work of Hippocrates and one of Galen, and the first germ of his *Gargantua* (1532 or 1533). The first part of his *Pantagruel* appeared under the anagram of Alcofribas Nasier, within a year or so after the former work, and its success was such that it passed through three editions in one year. Soon after its publication Rabelais accompanied Jean du Bellay on an embassy to Rome. On his return to France he went first to Paris; but not long after he is found once more at Lyons, where the *Gargantua*, as we now have it, first saw the light (1535). The *Gargantua* and *Pantagruel* together form a single work professing to narrate the sayings and doings of the giant Gargantua and his son Pantagruel. In 1536 Rabelais was again at Rome, and on this occasion he obtained from the Pope absolution for the violation of his monastic vows, and permission to practise medicine and to hold benefices. Shortly afterwards he was granted a prebend in the abbey

of Saint Maur-des-Fossés by Jean du Bellay. In 1537 he took his degree of Doctor of Medicine at Montpellier, and lectured on Hippocrates. The next few years were as unsettled as regards his abode as any previous period of Rabelais's life, and it is difficult to follow him. Probably he was in Paris in 1546, when the third book of his *Pantagruel* appeared, but during most of 1546 and part of 1547 he was physician to the town of Metz. In the third book all the great moral and social questions of the day were discussed with the gaiety and irony peculiar to Rabelais, and with a freedom that roused the suspicion of the clergy, who endeavoured to have it suppressed. The favour of the king secured its publication, but it was with more difficulty that a licence was obtained for the fourth book from Henry II, who had succeeded Francis in 1547. This book did not appear complete till 1552. About 1550 Rabelais was appointed to the cure of Meudon, but he resigned his position early in 1553, and he died at Paris shortly after. He left the whole of the fifth book of his remarkable romance in manuscript. Rabelais was one of the first to give flexibility and finish to the yet rude and harsh language of his country. Boileau calls him *la Raison en masque*, and Rousseau, *le gentil maître François*. By many Rabelais has been set down as a gross buffoon, and there is much in his writings to justify the harsh judgment, though we must remember what was the taste of his times. As regards the purpose of his work, many have looked upon Rabelais as a serious reformer of abuses, religious, moral, and social, assuming an extravagant masquerade for the purpose of protecting himself from the possible consequences of his assaults on established institutions. The earlier books were translated into English by Sir Thomas Urquhart (1653), who found a continuator in Motteux. It has been claimed for this translation that it is the best translation ever made; it is certainly worthy to stand beside François Victor Hugo's translation of Shakespeare, and Rogers's version of Aristophanes.—BIBLIOGRAPHY: P. Stapfer, *Rabelais: sa personne, son génie, son œuvre*; A. A. Tilley, *François Rabelais*; Sir W. Besant, *Rabelais* (Foreign Classics for English Readers Series).

Rabies (rā'bi-ēz), the name given to a disease, probably a kind of blood-poisoning, with which dogs, horses, cats, wolves, and other animals are attacked, and to which, indeed, all animals are said to be liable. A bite from some rabid animals induces hydrophobia in man. See *Hydrophobia*.

Rac'eme, in botany, a form of inflorescence in which the primary axis is elongated, and bears flowers placed on pedicels of nearly equal length, as in the currant and lily-of-the-valley.

The inflorescence is centripetal or indefinite. It differs from a spike only in the flowers not being sessile. See *Inflorescence*.

Rachel (rā-shell), Mademoiselle (Elizabeth Rachel Felix), French *tragédienne*, of Jewish extraction, born in 1821, died in 1858. For a time she gained her living by singing in the streets of Lyons, but being taken notice of, she was enabled to receive a course of instruction at the Conservatoire, and made her début in 1837 on the stage of the Gymnase at Paris. On 12th June, 1838, she appeared at the Théâtre Français, where she took the Parisian public by storm by the admirable manner in which she impersonated the classic creations of Racine and Corneille. Her reputation was speedily established as the first tragic actress of her day. In 1841 she visited England, and was received with the greatest enthusiasm. Her renown continued to increase, and for many years she reigned supreme at the Théâtre Français, making also tours to the provincial towns of France, to Belgium, &c. She died of consumption. Her life has been written by the French statesman Louis Barthou (q.v.).

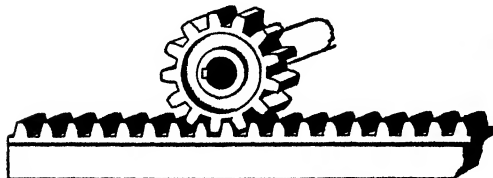
Rachis (rā'kis), in botany, a branch which proceeds nearly in a straight line from the base to the apex of the inflorescence of a plant. The term is also applied to the stalk of the frond in ferns, and to the common stalk bearing the alternate spikelets in some grasses.

Racine (ra-sēn), Jean Baptiste, French dramatist, born at La Ferté-Milon (Aisne) 1639, died at Paris 1699. He was educated at Port-Royal, the famous Jansenist institution, and subsequently at the Collège d'Harcourt. After writing an ode, called *La Nympe de la Seine*, in honour of the king's marriage, and two comedies, now lost, he made the acquaintance of Boileau and Molière, and began to write for the stage. His first tragedy, the *Thébaïde*, or *Les Frères Ennemis*, was performed by Molière's troupe at the Palais-Royal in 1664, as was also his next, *Alexandre*, in 1665. His first masterpiece was *Andromaque*, which on its performance at the Hôtel de Bourgogne, in 1667, produced a profound impression. The immediate successor of *Andromaque* was *Les Plaideurs* (1668), a witty and delightful imitation of the *Wasps* of Aristophanes. His next pieces were *Britannicus* (1669); *Bérénice* (1670); *Bajazet* (1672); *Mithridate* (1673); *Iphigénie* (1674); *Phèdre* (1677), the last piece that Racine produced expressly for the theatre. In 1673 he obtained a seat in the French Academy. His withdrawal from the theatre in 1677 was partly due to chagrin at the success of a hostile party of theatrical critics who applauded a writer now never heard of at the expense of Racine. At this period his friends persuaded him to marry, and soon after

(1678) he was appointed, along with Boileau, historiographer to the king, whom he accompanied in his campaign to Flanders. After a silence of twelve years Racine, at the solicitation of Madame de Maintenon, wrote two other pieces—*Esther* (1689) and *Athalie* (1691). His death is said to have been hastened by grief at losing the favour of the king. As a dramatist Racine is usually considered the model of the French classical tragic drama, and in estimating his powers in this field it is necessary to take into account the stiff conventional restraints to which that drama was subjected. What he achieved within these limits is extraordinary. It has been objected that he has introduced too much love into his pieces, and that he has represented his tragic princesses and heroines as too susceptible to love. To this, however, he was led not only by his own disposition but also by the character of his age. He wrote as a Frenchman for Frenchmen of the old type, in whom heroism and gallantry were combined, and he succeeded in depicting with truth and tenderness the feelings of a delicate and high-minded chivalry, and of a pure and ardent love. Besides his dramas Racine is the author of epigrams, odes, and hymns, &c. —BIBLIOGRAPHY: G. Larroumet, *Racine in Les grands écrivains*; P. Robert, *La poétique de Racine*; Jules Lemaitre, *Jean Racine*; D. F. Canfield, *Corneille and Racine in England*.

Racine (ra-sen'), a city of Wisconsin, United States, the county seat of Racine county, on Lake Michigan, at the mouth of Root River; served by the Chicago, Milwaukee, & St. Paul, and the Chicago & North-Western Railways, and by electric-traction lines to Chicago. There is a good harbour. Racine College (Protestant) and St. Catherine's Academy (Roman Catholic) are notable institutions. Agricultural machinery, carriages, motors, and wagons are manufactured. Racine was settled in 1834 as Port Gilbert, and became a city in 1848, the present name having been adopted in 1837. Pop. (1920), 58,593.

Rack, a mechanical device by means of which rotary motion can be obtained from, or is converted into, rectilinear motion. The mechanism consists of two parts: one a metal bar with



Rack and Pinion

teeth cut on one edge, and the other a small toothed wheel or pinion. An illustration of its

use can be seen in the gear for opening and closing sluice gates in water races or in the device used in some commercial motor vehicles to tilt the wagon in the process of emptying it.

Rackets, or **Racquets**, is a comparatively modern game, resembling fives in so far as it is played against the wall of a specially built 'court', usually roofed and with ample skylights; but it is allied rather to tennis by the employment of a racket instead of the hand for striking the ball. The head of this racket, tightly strung with catgut, is now usually rounder in shape than that used for tennis. The ball, made of layers of cloth covered with kid, is very hard, weighs about 1½ oz., and is 1½ inches in diameter. The court should be about 30 feet broad by 60 feet deep. Its front wall, faced by the players, has a horizontal 'service' or 'cut' line marked at a height of 9 feet 6 inches from the ground, while the lower portion is boarded to a height of 20 inches. The game may, like tennis, be played by either two or four players. The 'hand-in' player, who first 'serves' the ball, takes his stand in one of the two 'service-boxes', 6 feet square, placed on each side of the court. He must strike the ball against the front wall above the 'cut' line in such a manner that it will drop into the side of the court opposite to his own after having hit the side or back walls; it is there struck by the opposing player before it has twice touched the ground, and must be returned to strike the wall above the boards. 'Squash rackets' is a somewhat less exacting variety of the game, played with a larger ball. For rules of play and other details, see J. Marshall, *Rackets* (1890); E. O. Pleydell-Bouverie, *Rackets* (Badminton Library); and Eustace H. Miles, *Rackets, Tennis, and Squash*.



Raccoon (*Procyon lotor*)

Raccoon', or **Raccoon'**, an American plantigrade carnivorous mammal, the common raccoon being the *Procyon lotor*, the specific name having reference to its curious habit of dipping its food in water. It is about the size of a small fox, and its greyish-brown fur is deemed valuable, being

principally used in the manufacture of hats. This animal lodges in hollow trees, feeds occasionally on vegetables, and its flesh is palatable food. It inhabits North America from Canada to the tropics. The black-footed racoon of Texas and California is *P. nigripes*. The agouara or crab-eating racoon (*P. cancrivorus*) is found farther south on the American continent than the above species, and is generally larger.

Radcliffe, Ann, novelist, born in London in 1764, died 1823. She married, at the age of twenty-three, William Radcliffe, afterwards editor and proprietor of *The English Chronicle*. She published in quick succession *The Castles of Athlin and Dunboyne*, a Highland story; *A Sicilian Romance*; and *The Romance of the Forest*. Her masterpiece is considered to be *The Mysteries of Udolpho* (1794), which was long very popular. The last of her novels published during her life was *The Italian* (1797). A posthumous romance, *Gaston de Blondeville*, was edited by T. N. Talfourd in 1826, together with some poetical pieces. Mrs. Radcliffe had considerable power in the description of scenery, and knew how to excite and maintain the curiosity of her readers; but her characters are insipid, the world in which they move is unreal, and the conclusion of her stories lame and impotent.

Radcliffe, an urban district and town of Lancashire, England, on the Irwell; served by the Lancashire & Yorkshire Railway. The church of St. Bartholomew dates from the reign of Henry IV. There are calico-printing, cotton-weaving, dyeing, and other industries. Pop. (1921), 24,677.

Radcliffe Library, a library founded in connection with Oxford University out of funds destined for the purpose by Dr. John Radcliffe (1650-1714), physician to the Princess Anne of Denmark, and opened in 1749. The building erected by the Radcliffe trustees for the reception of the books forming the library is now used as a reading-room in connection with the Bodleian Library. An observatory in connection with the university was founded in 1772 by the Radcliffe trustees.

Radhanpur, a native state and town of India, in the Pālanpur agency of Bombay. It is flat and open, traversed by three rivers that dry up in the hot season, and has mean temperatures of 41° F. in January and 115° F. in June. December to March is the cool season; between April and July and in the months of September and October the heat is excessive. Cotton, wheat, and commoner food grains, but no irrigated crops (excepting vegetables), are produced. Saltpetre is manufactured. Radhanpur, the only town, is the capital. It is surrounded by a wall, and contains a castle, also surrounded by a wall, which is the residence

of the Nawāb. A considerable number of roads converge on the town, which is therefore a trade centre for Cutch and Northern Gujarāt. State area, 1150 sq. miles; pop. 67,000 (mainly Hindus); pop. (town), 12,000.

Radia'ta, the name given by Cuvier to his fourth great division of the animal kingdom, including those animals whose parts are arranged round an axis, and display more or less of the 'rayed' appearance or conformation. In modern zoology Cuvier's division has been abolished, and the radiata have been divided into several phyla.

Radia'tion, the propagation from a body of vibrational energy in the form of waves through the ether or through a material medium. The present article refers only to the phenomena of heat and light. A hot body emits wave energy into the surrounding medium and loses heat. The waves travel with the velocity of light in straight lines; they are subject to reflection, refraction, polarization, &c., like waves of light, and are absorbed, reflected, or transmitted by bodies on which they fall. The rate of emission by the hot body from a unit of area of its surface depends on the difference of temperature between the body and the medium, and also on the emissive power or emissivity of the surface. Melloni (1798-1854) found that the relative emissive powers of various substances at 100° C. varied from 100 for lampblack to 13 for metals, and he also showed that these relative emissive powers were the same as the relative absorbing powers. Kirchhoff proved (1860) that the ratio of the radiating power to the absorbing power is the same for all bodies, the radiating power being measured by the quantity of energy radiated per square centimetre per second, and the absorbing power by the fraction of the incident energy which is absorbed, these being measured at the same temperature. Langley showed by experiment (1881) that with rise of temperature the radiation of each wave-length increases in intensity, and new radiations of shorter wave-length appear. He invented the bolometer, an instrument for measuring radiant heat, and employed it to investigate the heat spectra of the sun and moon. The whole spectrum may be divided into ultra-violet, visible, and infra-red portions, and these may be regarded as the seats of photographic or chemical, light, and heat actions respectively; but this does not hold strictly; there is overlapping, and heat effects, for instance, are discernible in the chemical spectrum.

Various instruments have been employed to detect and measure heat radiation. Melloni used, in his experiments, a thermopile, made up of a number of thermo-junctions of bismuth and antimony, in conjunction with an

astatic galvanometer. Vernon Boys used a much more sensitive instrument known as a radiomicrometer, formed by hanging up, by a fine quartz fibre, between the poles of a strong horse-shoe magnet, a thermoelectric loop on one junction of which the radiation was directed, giving rise to a current which deflected the loop, the deflection being read by means of a lamp, mirror, and scale. Langley's bolometer depends on the change in electrical resistance which takes place in a metal with rise of temperature (see *Spectrobolometer*). By means of this instrument Langley mapped the infra-red spectrum of the sun, and showed that, like the visible portion, it possesses many 'lines'. He recorded 600 lines between the wave-lengths 1.8μ and 5.3μ (μ , a micron or thousandth part of a millimetre).

With the aid of the bolometer a careful investigation was made by Wien, Paschen, Lummer, Pringsheim, Kurlbaum, and others of the relation between radiation energy and temperature. Kirchhoff had suggested the idea of a perfect radiator and perfect absorber, with which other bodies might be compared. A near approach to this is found in black bodies; for example, black velvet is found to absorb 99.6 per cent of incident radiation. The perfect radiator has therefore become known as the 'black body', and Lummer and Pringsheim realized an experimental black body by heating or cooling a hollow vessel blackened in the interior, and using the radiation from the internal surface which emerges through a small hole in the wall of the vessel. With the aid of the bolometer they proved that the wave-length of the dominant radiation of the black body is inversely proportional to the absolute temperature of the body (Wien's Law), also that the total radiation given out per second is proportional to the fourth power of the absolute temperature of the body (Stefan-Boltzmann Law), and, further, that the amount of energy radiated in the dominant wave was proportional to the fifth power of the absolute temperature of the body. In the first case the constant of proportionality is 2900, if the wave-length is expressed in microns. This gives a means of calculating temperatures. Assuming that the sun gives 'black body' radiation, the dominant wave in the sun's spectrum is 0.5μ in length; this gives, for the sun's temperature, $2900 \div 0.5$, or 5800° absolute. Lummer and Pringsheim have further shown that in non-black bodies, such as platinum, the total radiation varies as the fifth power of the absolute temperature. Planck has given a formula for radiation energy (see *Radiation, Theory of*) which gives values agreeing closely with the values of radiation energy found by different observers. It is employed,

with others of the foregoing results, as the basis of optical pyrometry (see *Pyrometer*).

Radiation, Theory of. Radiation is any influence proceeding from a source in straight lines, so that an obstacle in front of a point source throws a shadow which is its geometric projection. The known influences of this kind can be divided into two groups (see *Rays, Electric; Radio-activity*): (a) particle radiations, e.g. α - and β -rays, cathode and positive rays; (b) electromagnetic radiation, i.e. Hertzian rays, all kinds of light, X-rays, and γ -rays. Group (a) will not be considered at all here; most of group (b) will be considered only in connection with a fundamental difficulty affecting all its members. But one member of (b), which is usually referred to by the term Theory of Radiation, will be discussed more specifically.

This is thermal radiation. All bodies, if heated to a sufficiently high temperature, emit light, which when resolved by the spectroscope (q.v.) forms a continuous spectrum. In general the light is more intense, and its average frequency is greater (i.e. the light is bluer and less red), the greater the temperature of the body. If the temperature is below that at which visible light is emitted, there is still emitted a radiation (formerly called radiant heat and now infra-red radiation) which has all the characteristic properties of light, except visibility, and is now known to differ from light only because all but an inappreciable fraction of it consists of radiation of frequency too low to affect the eye. Even if the body is cooled below and not heated above its surroundings, it still emits thermal radiation; but since this radiation increases in general with the temperature, it receives from its surroundings more than it gives to them, and is therefore heated and not cooled. Nowadays no distinction is recognized between the thermal radiation, emitted by any body at any temperature, and light, emitted from any source, except in the relation between the intensity of the radiation and the frequency.

This relation has been the subject of much investigation. Let $E_\nu dt d\sigma d\omega d\nu$ be the energy of the radiation having a frequency between ν and $\nu + d\nu$ emitted in time dt from a surface of the body of area $d\sigma$ in a direction lying within a solid angle $d\omega$ round the normal to that surface. Then E_ν is called the intensity of the radiation of frequency ν . The following laws concerning E_ν can be established experimentally:

1. In general E_ν increases with the temperature T (absolute) of the emitting surface (source), but is independent of the temperature of the surrounding bodies.

2. In general E_ν is a maximum for some particular value of ν , and this value of ν is greater the greater the temperature. Sources

which are exceptions to (1) and (2) are said to show selective-radiation.

3. E_ν at any particular T and ν , and the change of E_ν with T and ν , vary with the nature of the body forming the source. The variation is comparatively slight if similar sources (e.g. two metals) are compared, but is very great if, e.g., a metal is compared with a gas.

4. Let A_ν be the absorption coefficient of the source for radiation of frequency ν , i.e. the proportion of that radiation which is absorbed

when it falls on the source. Then $\frac{E_\nu}{A_\nu}$ is the same for all sources for the same values of ν and T ; the variations of (3) do not appear in this ratio. (Kirchhoff's Law.)

It follows from (4) that all sources for which A is the same emit the same radiation at the same temperature. If a small deep hole is bored in any body, any radiation entering the hole is totally absorbed within it after repeated reflections; accordingly for such a hole $A_\nu = 1$ for all values of ν , i.e. the hole is perfectly black, whatever is the nature of the surrounding body. It is actually found that the radiation proceeding from such a hole is independent of the body in which it is bored. Such radiation, emitted by a perfectly black body, is called 'black-body', or 'complete', or 'full' radiation.

The intensity of complete radiation of frequency ν is determined by the temperature only. The relation between E_ν , ν , and T has been very carefully studied and shown to be consistent with the equation

$$E_\nu = C_1 \nu^3 / (e^{C_2/\nu T} - 1) \dots (1) \text{ (Planck's Law),}$$

where $C_1 = 7.28 \times 10^{-48}$ erg sec.³/cm.² and $C_2 = 4.86 \times 10^{-11}$ sec. E , the total intensity of the radiation of all frequencies in complete radiation, is $\int E_\nu d\nu$, so that by (1)

$$E = 8.50 \times 10^{-6} T^4 \text{ erg/(cm.}^2 \text{ sec.)} \dots (2) \text{ (Stefan's Law).}$$

It should be noted for subsequent reference that if $\frac{T}{\nu}$ is very great, (1) reduces to

$$E_\nu = (C_1/C_2) \cdot \nu^2 T \dots (3) \text{ (Rayleigh-Jeans' Law).}$$

So much for experiment; we now turn to theory. If we assume (a) the conservation of energy; (b) that two bodies in an enclosure thermally insulated from each other and from all other bodies would eventually reach the same temperature by means of their mutual radiation; (c) that their final temperature will not be reduced to absolute zero; then it can be established that Kirchhoff's Law must be true. In the steady state finally reached in the enclosure there will be a definite concentration of radiant energy in the enclosure, which is in thermal

equilibrium with the bodies and may be regarded as having the same temperature. If it is assumed further (d) that a small hole made in the enclosure, permitting an infinitesimal fraction of the radiation to escape, does not materially disturb the equilibrium, then the complete radiation from a perfect black body which is studied experimentally must represent this equilibrium radiation. Its independence of the nature of the enclosure in which the hole is made is explained.

There remains to be explained the form of Planck's Law, stated in (1). Wien, by considering the pressure exerted by radiation on a surface on which it falls, proved from general thermodynamic theory that the relation must be of the form $E_\nu = \nu^3 f(\nu/T)$, which includes both (1) and (3) (Wien's Displacement Law). But the determination of the form of the function f requires further assumptions. The principles of generalized mechanics as stated by Lagrange and Hamilton would be sufficient for this purpose; but it is now agreed that (1) is inconsistent with those principles, which must necessarily lead to the conclusion that (3) is valid, not only when T/ν is large, but always. The deduction involves (d) as well as the assumption (e) that different frequencies represent different 'degrees of freedom' and can vary independently. Attempts were made at one time to save classical mechanics by denying (d) or (e); but they are now abandoned.

On the other hand, (1) follows from a quantum theory (q.v.) which asserts that the quantum states of frequency of radiation ν are those in which the energy is $mh\nu$, where m is an integer and h is Planck's constant. This theory leads to the relation

$$E_\nu = (h\nu^3/c^2) \div (e^{h\nu/kT} - 1) \dots (4),$$

where c is the velocity of light, and kT is two-thirds of the kinetic energy of the molecule of a perfect gas at temperature T . Comparison of (4) with (1) leads to $h = 6.56 \times 10^{-27}$ erg-sec., $k = 1.35 \times 10^{-16}$ erg, values agreeing perfectly with those determined from entirely different phenomena. This quantum theory, due to Planck, was historically the first and introduced for the first time the universal constant h . But since a completely logical deduction of (4) presents some difficulty, the most convincing evidence for the replacement of classical mechanics by quantum theory comes to-day from other sources.

However, such a replacement leads to grave difficulties in the general theory of electromagnetic radiation. A few years ago the undulatory theory (see *Light; Ether*) of such radiation was unquestioned; it explained perfectly some of the characteristics of radiation, e.g. rectilinear

propagation, interference, regular reflection and refraction; and the explanation involved the assumption that energy is transferred continuously from one part to another of the medium through which the radiation passes. Other characteristics, of which that which has just been discussed is an example, are inconsistent with it. It is possible to divide the properties of radiation sharply into two classes, of which one is explicable by a continuous undulatory theory and not by a quantum theory, while for the other the position is reversed.

Many attempts have been and are being made to remove this contradiction. At first the tendency was to modify slightly the undulatory theory while retaining the essential feature of it. Of such attempts J. J. Thomson's 'string theory' of the ether (q.v.) and Einstein's 'light quantum' theory may be mentioned as examples. They are intended primarily to explain the photo-electric effect (q.v.), and especially the remarkable fact that, in some circumstances, bodies can apparently absorb from radiation more energy than falls on them. It is suggested that the disturbance which constitutes radiation is periodic in time and space, as the undulatory theory suggests, but that it is wholly concentrated in a small volume and does not spread out spherically from a point source. But all such theories only cover part of the field, and are apt to introduce more difficulties than they remove.

The tendency now is rather to abandon the older kind of explanation (which was intimately connected with the acceptance of the concepts of mechanics), and to seek merely formal statements of great generality from which all the facts can be deduced without logical inconsistency. Thus the two classes of properties mentioned above can be formally distinguished as those involved in processes which produce no resultant change in radiant energy (to these classical mechanics applies), and those in which radiant energy is given to or taken from material systems (to these quantum theory applies). The problems of the former have long been solved. For the latter a quantum theory so general has been propounded that it can always be predicted what interchange of energy there will be when a process of the second class takes place; but no equally general theory is yet available to predict in what circumstances such a process will occur. (Thus we know how much energy an electron will take from radiation if it is emitted photo-electrically; but we do not know theoretically what proportion of electrons exposed to the radiation will absorb energy.) The attempts to provide such a theory usually start from the fact that, when the change in the quantum number of a system (see *Quantum*

Theory) is very small compared with the quantum numbers of the initial and final states, the series of quantum states becomes practically continuous and classical principles lead to the same result as quantum theory. Accordingly the problem is to find some formal relation which in this limiting case reduces to the relation of Maxwellian electrodynamics and yet is in accordance with the facts when the changes are perceptibly discontinuous. The most general relations of this kind proposed as yet are Bohr's Principle of Correspondence, of great importance in the Theory of Spectra (q.v.), and Ehrenfest's Principle of Adiabatic Invariance. But to state either of these completely is beyond the scope of this article. When the desired principle has been found, the classical theory of radiation will appear as a special case of a very general quantum theory, and though no 'visualizing' explanation of radiation will be offered, or appear possible, the two classes of radiation processes, at present so sharply distinguished, will have been brought into complete harmony.

BIBLIOGRAPHY: M. Planck, *Die Theorie der Wärmestrahlung* (translated); J. H. Jeans, *Report on the Quantum Theory of Radiation* (Physical Society publication); E. P. Adams, *Quantum Theory* (published by the National Research Council of America, 1916); N. R. Campbell, *Modern Electrical Theory* (second edition); L. Rougier, *Philosophy and the New Physics* (translated by M. Masius: Blakiston, Philadelphia, 1921).

Radicals, advanced Liberals in politics. Opposed to the Whigs, or moderate Liberals, they were the pioneers and ardent advocates of thorough political reform on broad democratic lines throughout the nineteenth century. Although heard before the end of the seventeenth century, the term did not actually come into vogue until near the end of the eighteenth, being first applied to Henry ('Orator') Hunt, who was imprisoned for a speech in connection with the Peterloo 'massacre' at the Manchester reform demonstration, 16th July, 1819. In those days Radicals were known as 'White Hats', because of the headgear of the leaders. Since the rise of the Labour party, the term Radical has fallen into disuse, but its ideas have permeated sections even of the Conservatives, and the designation Liberal now implies Radicalism. The Radicals were never a separate party, and reached their zenith, under the leadership of Joseph Chamberlain, about 1885, when they put forward a programme for the general election of that year.

Radio-activity. The term 'radio-active' is applied to a class of elements, such as uranium, thorium, and radium, which possess the peculiar property of emitting continually and *spontaneously*

taneously radiations which are capable of passing through sheets of metal and other substances which are opaque to ordinary light. These radiations, in addition to affecting a photographic plate, have also the property of discharging an electrified body (see *Rays, Electric*). It has been shown that the emission of these radiations is due to an actual disintegration of the radio-active element, which is transformed in the process into a completely distinct element. In some cases this radio-active disintegration, as it is termed, is not attended with the emission of any perceptible radiations. These 'rayless' changes, however, follow exactly the same laws as those accompanied by radiations, and are included in the general term 'radio-active'. As a matter of fact, electrons are given off during these rayless changes, but with such small velocities that they do not exhibit the characteristic properties of electric rays.

The first important discovery in the subject of radio-activity was made by Becquerel in Feb., 1896, who found that the double sulphate of uranium and potassium emitted radiations which produced an impression on a photographic plate enveloped in black light-proof paper. He found that a similar effect was produced by any salt of uranium, and by the metal uranium itself. It is thus a specific property of the element. A compound of uranium gives off three types of radiation α -, β -, and γ -radiations (see *Rays, Electric*). The photographic effect discovered by Becquerel was due to the β -rays, as the α -rays would be absorbed by the wrapping of the plate, while the γ -rays are too feeble to produce a measurable impression during the time of exposure employed.

In 1900 Sir William Crookes discovered that it was possible by a single chemical operation to separate the uranium into two fractions of very unequal bulk. If ammonium carbonate is added to a solution of a uranium salt, and the precipitate is dissolved in excess of the reagent, a trace of the precipitate remains undissolved, consisting chemically of the impurities present in the original solution. In this precipitate is concentrated the whole of the β -ray activity of the original salt. The solution, containing practically the whole of the original uranium, is, when tested photographically, completely inactive. The β -rays are therefore not emitted by uranium itself, but by some new substance which can be separated from it by a simple chemical reaction. To this substance Crookes gave the name uranium X.

If the two fractions are kept under observation for some weeks, it is found that the uranium X gradually loses its activity, the intensity of the radiation falling to half its original value in 24.6 days. The inactive solution begins again to

emit β -rays, and at the end of 24.6 days has recovered one-half of its original radiating power. In fact, the total activity is constant throughout. Immediately after the separation it is concentrated in the uranium X precipitate, while the original salt is inactive. At the end of a few months the precipitate is quite inactive, while the solution has regained the whole of its original activity. The separated uranium salt, although it does not emit β -rays emits α -radiation at a rate which is constant, and is not affected by the separation of the uranium X.

The rate of decay of the activity of uranium X follows an exponential law. Thus if I_0 is the initial intensity, and I_t the intensity after an interval t has elapsed, $I_t = I_0 e^{-\lambda t}$, where e is the base of the natural logarithms, and λ is a constant which is known as the *radio-active constant* of the material. This exponential law of decay has been found to apply to all cases of radio-active disintegration where it has been possible to test it. The radio-active constant of a substance is apparently quite uninfluenced by change in physical conditions. The rate of decay of uranium X, for example, is exactly the same at a red heat as at the temperature of liquid air. This differentiates radio-active phenomena very markedly from ordinary chemical reactions.

The phenomena of radio-activity can be explained on a theory of radio-active change due to Rutherford. It is assumed (a) that there is a continuous production of new radio-active substance (uranium X in the case just considered) from the original element (uranium) at a rate which is proportional to the amount of the original substance actually present, and (b) that the new substance itself disintegrates at a rate which is also directly proportional to the amount of it actually present. The intensity of the radiations is assumed to be proportional to the quantity of the radiating substance. These assumptions have proved sufficient to account for all radio-active phenomena so far observed.

Their application to the case of uranium is particularly simple (1) because the rate of decay of uranium is so small (it has been estimated that it would decay to one-half its original amount in 5×10^9 years) that the quantity of it present may be regarded as constant during the experiment, and (2) because the product of the decay of uranium X is so very feebly active that it does not sensibly affect our observations. Suppose we have a quantity of uranium which has been freed from uranium X. The latter will be produced from the uranium at a constant rate, and the quantity of it present will thus increase. The uranium X, however, is decaying from the moment of its formation at a rate which is directly proportional to the amount

of it which has actually collected, and which, therefore, increases as time goes on. A stage will thus be reached when the rate at which the uranium X is disintegrating becomes equal to its rate of formation. After this the proportion of uranium X to uranium in the mixture will be constant. This is known as *permanent radio-active equilibrium*. The separated uranium X, when cut off from its source, will disintegrate at a rate which is proportional at any instant to the amount of it still present. The exponential law of decay is simply a mathematical expression of this assumption. It can be shown that when permanent radio-active equilibrium has been reached, the quantity of each of the radio-active substances present in the mixture is inversely proportional to its radio-active constant.

If the uranium, instead of being practically constant in quantity, were to decay at a rate which, though measurable, was slow compared with that of uranium X, it is easy to see that the two substances would still reach a state of mutual equilibrium, but that the actual amount of each still present would decrease owing to the decay of the parent substance, and at the same rate. This is known as *transient radio-active equilibrium*, an important instance of which is the case of radium emanation and its products. The proportion of the derived substance present will be rather greater in the case of transient than of permanent equilibrium. Since the rate of decay of each of the products is governed by that of the parent substance when equilibrium has been attained, the radiation from any of these derived substances may be used as a measure of the amount of the parent substance still present.

The discovery by Mme Curie that some ores of uranium were several times more active than uranium itself led to the isolation, in 1898, of a new radio-active element, which, weight for weight, is nearly 2 million times as active as uranium, and to which the name of radium (q.v.) was given. This is by far the most important of the radio-active elements. Since its half-value period is only 1730 years, obviously it is still being continuously produced on the earth, and the fact that the ratio of radium to uranium in uranium ores is practically constant indicates that it is one of the decomposition products of uranium, in radio-active equilibrium with its source. It is not, however, the immediate product of the decay of uranium X, two other substances, uranium 2 and ionium, intervening between uranium X and radium. The full family tree is given in the table opposite.

Radium itself emits only α -radiation. Within a very few hours after its preparation, however, an emission of β - and γ -radiation begins, owing to the formation of other radio-active decomposition products. A sealed tube containing a

radium salt will therefore emit all three types of radiation.

The phenomena of radio-active change are particularly striking in the case of radium, as the first product of its disintegration is a gas known as radium emanation. The existence of a radio-active gas was first recognized by Rutherford in the case of thorium, an element which is also radio-active. It was found that measurements of the activity of this substance were liable to strange fluctuations, which were finally traced to the emission by thorium of a radio-active 'emanation' which was carried about by air-currents. The name 'emanation' was invented to avoid prejudice as to its actual nature. The emanations have since been shown to possess all the characteristics of gases of high atomic weight, and to belong chemically to the group of inert gases of which helium, neon, and argon are the first members.

Radium emanation decays to half value in 3.85 days, so that a few weeks are sufficient to establish radio-active equilibrium between the two. The quantity of emanation in equilibrium with a gramme of radium is known as a *curie*, and this unit and its subsidiary unit the *milli-curie* (one-thousandth of a curie) are now generally employed as standards of radio-activity. The volume of one curie of emanation at normal temperature and pressure is only 0.59 cubic millimetre. In spite of the smallness of this volume, not only has its boiling-point been determined (-65°C.) but also its density, which was found by Ramsay and Gray to be 111 times that of hydrogen. Its atomic weight is therefore 222, assuming that, like helium and argon, it is monatomic. This is exactly what we should expect if the atom of radium emanation was formed from an atom of radium from which an α -particle (which has been shown to be an atom of helium of atomic weight 4) had been expelled. The correspondence is very convincing evidence in favour of the theory of atomic disintegration. Radium emanation can be most conveniently extracted from radium salts by dissolving them in water. On lowering the pressure a considerable proportion of the emanation is evolved, together with a much larger volume of hydrogen and oxygen from the decomposition of the water. The emanation may be purified by first sparking the mixed gases to remove the hydrogen and oxygen, and then passing the residual gas through a tube immersed in liquid air, where the emanation condenses, probably to a solid. On removing the tube from liquid air the emanation volatilizes, and can be pumped into small glass tubes in a practically pure state. It is in this form that radio-active material is generally employed in medical treatment.

TABLE OF RADIO-ACTIVE ELEMENTS

Uranium-Radium Series.			Uranium-Actinium Series.			Thorium Series.		
Element.	Half-value Period.	Radiation Emitted.	Element.	Half-value Period.	Rays Emitted.	Element.	Half-value Period.	Rays Emitted.
Uranium 1	5×10^8 years	α	Uranium Y	1.5 days	β (slow)	Thorium	1.8×10^{10} years	α
Uranium X ₁	1.5 days	β (slow)	Protactinium	10^4 years	α	Mesothorium 1	5.5 years	—
Uranium X ₂	24.6 days	β (slow)	Actinium	30 years	β, γ	Mesothorium 2	6.2 hours	β, γ
Uranium 2	1.15 min.	β, γ	Radioactinium	19.5 days	α	Radiothorium	2.0 years	α
Ionium	2×10^4 years	α	Actinium X	11.4 days	α	Thorium X	3.64 days	α
Radium	2×10^4 years	α	Actinium emanation	3.9 sec.	α	Thorium emanation	54 sec.	α
Radium emanation	1730 years	α	Actinium A	.002 sec.	α	Thorium A	0.14 sec.	α
Radium A	3.85 days	α	Actinium B	36.1 min.	β (slow)	Thorium B	10.6 hours	β (slow)
Radium B	3.0 min.	α	Actinium C	2.15 min.	α	Thorium C	60 min.	α
Radium C	26.7 min.	β (slow)	Actinium C ₂	—	—	Thorium D	3.1 min.	β, γ
Radium C ₁	19.5 min.	β	Actinium D	4.71 min.	β, γ	Thorium C ₄	10-11 sec.	α
Radium C ₂	1.4 min.	β	Lead	—	—	Lead	—	—
Radium C ₃	10-6 sec.	α						
Radium D	16.5 years	β (slow)						
Radium E	5.0 days	β (slow)						
Polonium	136 days	α						
Lead	—	—						

Radium emanation itself emits only α -radiation. If a wire is exposed to the emanation, it becomes radio-active, emitting α -, β -, and γ -rays. The activity is particularly marked if the wire during exposure is negatively charged. The effect was at first ascribed to an 'induced' radio-activity in the wire. It has been shown to be due to the deposition on the wire of solid radio-active substances formed by the decay of the emanation. This activity rapidly decays when the wire is withdrawn, as the immediate products are all short-lived. If the emanation is kept in a sealed tube, a state of transient equilibrium is set up after a few hours, and the products then decay with the period of the emanation itself.

In addition to what we may call the radium series, uranium also gives rise to another chain of radio-active substances, of which actinium is the principal member, corresponding to a different mode of disintegration on the part of the uranium atom. The element thorium is also radio-active, and gives rise to a third chain of radio-active substances. Comparatively few of the radio-active substances exist in sufficient quantity to enable their properties to be observed directly. They can only be identified and examined by the radiations which they emit. It seems almost certain that the final product of the long series of radio-active changes is in each case the element lead.

The chemical classification of the thirty-five new radio-active elements has been attempted by Soddy. The emission of an α -particle, as we have seen, reduces the atomic weight by 4. The emission of β - and γ -radiation produces no sensible change in the atomic weight, but as it increases the resultant charge on the atomic nucleus, we should expect it to produce a change in the chemical properties of the atom. Soddy assumed that the emission of an α -particle produced a new element, whose position in the Periodic Table of the elements was two spaces to the left of the element from which it was so formed. The emission of β -radiation moved the position of the new element one space to the right. Thus the emission of an α -particle by uranium 1, which has an atomic weight of 238 and belongs to Group VI of the Periodic Table (q.v.), produces a new element, uranium X_1 , of atomic weight 234, which should be placed in Group IV. Uranium X_2 (or *brevium*, Bv), formed from uranium X_1 with the emission of β -radiation only, has also an atomic weight 234, but belongs to Group V, while similarly uranium 2 has an atomic weight of 234, but belongs, like uranium 1, to Group VI. Thus uranium 1 and uranium 2 not only belong to the same chemical group but occupy the same space in the table. They would thus be expected to show identical physical

and chemical properties and to be inseparable by any chemical process. Such substances are known as *isotopes* (q.v.).—BIBLIOGRAPHY: Sir E. Rutherford, *Radioactive Substances and their Radiations*; F. Soddy, *The Interpretation of Radium*; J. A. Crowther, *Ions, Electrons, and Ionizing Radiations*; J. Chadwick, *Radioactivity and Radioactive Substances*.

Radiola'ria, an order of Protozoa (q.v.).

Radiology.—The science of radiology may be said to have originated in the discovery of X-rays (see *Rays, Electric*) by Röntgen in 1895. It embraces both 'electro-magnetic' and 'corpuscular' radiation, and is chiefly concerned with those rays employed for radiographic and therapeutic purposes. The corpuscular rays employed in radiology are those emitted by radio-active substances (see *Radio-activity*), the most important of which is radium (q.v.).

The Generation of X-rays.—X-rays as employed in modern medical radiology vary in wave-length from about $\frac{1}{10}$ Ångstrom unit to 10 units. (One hundred million Ångstrom units = 1 centimetre.) They are produced by firing at a tungsten target *in vacuo* a stream of electrons, the high speed of which is imparted by the application of an intense electric field generated either by an induction coil of suitable design, or by a high-tension transformer, the electric field being made unidirectional by the inclusion in the secondary circuit of the coil or transformer of a suitable synchronous rectifier. The voltages generated by these machines range from about 50,000 to 120,000 volts. The exhausted glass vessel in which the electrons are projected is known as an 'X-ray tube'. X-ray tubes are of two types, viz. (a) the gas tube as shown in fig. 1, and (b) the incandescent cathode tube, an example of

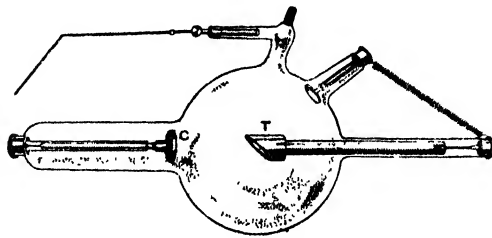


Fig. 1

which, known as the 'Coolidge tube', is shown in fig. 2. Several varieties of both types are in use. In the former type the emission of electrons from the negative electrode, termed the cathode, is dependent upon the electrical discharge in the residual gas, which has a pressure of only about one-millionth of an atmosphere. This is a development of the type of tube used by Röntgen and other pioneer workers. In the incandescent

cathode type of tube the exhaustion is practically complete, and is such that no discharge passes through the residual gas when the intense electric field is applied; instead, the free emission of electrons by incandescent metals is made use of, the cathode being in the form of a tungsten spiral heated by an electric current as in an ordinary incandescent electric lamp. The stream of electrons is focused on to an extremely small area of the tungsten target, which thus constitutes a point source of X-rays which are emitted in all directions above the plane face of the target. The rays are absorbed as they pass through the human body to a greater or less extent according to the density of the tissue passed through, with the result that the impression produced upon a photographic plate receiving the transmitted rays reveals to the experienced medical radiologist the detailed structure of the part under observation. The degree of penetration of the radiation produced depends upon the voltage generated by the induction coil and transformer. In all modern X-ray outfits the voltage can be controlled.

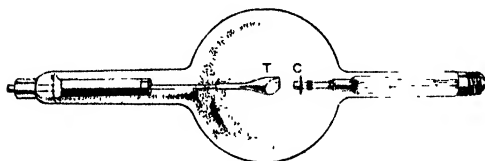


Fig. 2

Medical Applications of X-rays.—The applications of X-rays in medical practice are both diagnostic (radiography) and therapeutic (radiotherapy).

The great advance in the precision of medical and surgical diagnosis which has been made during recent years is largely due to the rapid advance of X-ray equipment and technique. Radiographs depicting the most minute detail of practically any part of the human body may be taken by exposures of less than one second. The expeditious production of these radiographs is rendered possible by an array of appliances, by means of which the X-ray tube and photographic plate or film may be quickly placed in suitable positions relative to the part of the patient to be examined, and to no less extent by the highly developed technique exercised by skilled lay radiographers trained under medical supervision. The equipment includes appliances for regulating the penetration of the rays and the exposure, both of which vary with the part of the body to be radiographed. A valuable part of the equipment is the fluorescent screen, which is rendered visible when irradiated by X-rays. By its use a preliminary visual diagnosis may be made, and it is of special use in the rapid locali-

zation of metallic foreign bodies, such as bullets and shell fragments, and also for the detection of pulmonary tuberculosis. X-ray examination lends itself to a multiplicity of diagnostic purposes, a few of the more important being the following: fractures; bone structures and deformities; arthritic and other diseases of the joints; detection of the presence of foreign bodies and their exact localization; diseases of the stomach and intestinal tract (diagnosis assisted by the use of special meals containing bismuth or barium which are opaque to X-rays); stones in the bladder, kidney, and gall bladder; incipient tuberculosis in the lungs and joints; dental malformations and diseases.

Radio-therapy is of more recent development than radiography, owing largely to the difficulty of measuring and controlling both dosage and quality of the rays, and the serious consequence of overdosage. Amongst the earlier successes is the treatment of ringworm, which is completely cured by the appropriate administration of X-rays of low penetration. X-radiation, if administered in suitable doses of the requisite penetration, is also found to possess valuable properties in the treatment of malignant diseases, such as rodent ulcer and the various forms of cancer. Excessive irradiation, however, produces bad effects upon the patient, and may even cause malignant growth. Many of the pioneer workers have suffered in this respect through exposing themselves unduly to X-rays, the damage in some instances having resulted in loss of life. White blood corpuscles are destroyed by the rays, and serious consequences in this direction may result from undue exposure. Further, the less penetrating radiation being absorbed readily by the skin causes dermatitis, which is insidious in onset, and, if acute, results in complete destruction of the tissue, causing it to present a permanent scaly appearance. On account of these harmful effects it is essential that X-ray operators be adequately protected from exposure to the rays, and modern tube-holders, &c., are provided with coverings of lead or rubber impregnated with lead to eliminate the harmful extraneous radiation. Considerable progress has been made in the treatment of deep-seated malignant growths. One of the most recent developments is the employment of highly penetrating X-rays according to what is known as the 'Erlangen' technique. Highly penetrating rays are produced by the use of special X-ray tubes and a duplex induction coil capable of developing voltages up to 200,000 volts. After filtration of the softer rays, the highly penetrating residuum is directed to the affected deep-seated tissue, and the administration of large intensities for short periods is claimed to be productive of very satisfactory results.

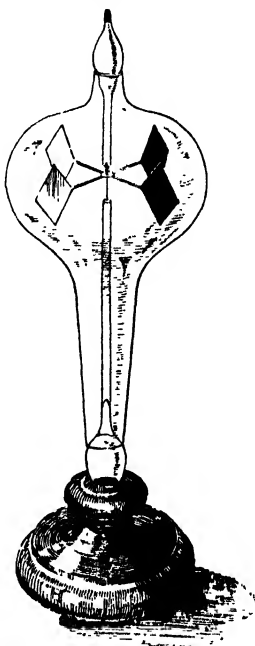
Radium and Radium Therapy.—The medical application of the radiation emitted by radio-active substances is confined to therapy, in which a certain amount of success has been achieved. The α -rays are very easily absorbed, and are consequently of little or no therapeutic value; the β -rays are much more penetrating; and the γ -rays, which are similar in character to X-rays, are more penetrating still, being much more penetrating than the hardest X-rays so far artificially produced. The absorption of γ -rays is accompanied by the emission of secondary β -rays, electrons being expelled from the absorbing atoms, and there is reason to suppose that the therapeutic action of γ -rays and even of X-rays is due to these secondary β -rays. When radium itself is employed for therapeutic work it is contained in a small thin platinum tube which absorbs the α -rays, but permits the transmission of both β - and γ -rays. When only γ -rays are required a second thicker tube of platinum is used in addition. The platinum tube can be inserted in the malignant growth, the destruction of which, rather than the surrounding healthy tissue, is thereby more certain than by irradiating from a distance. For some purposes radium compounds are made to adhere tenaciously to the surface of applicators of suitable form, the particular shape of the applicator being dependent upon the part to be treated.

Radium emanation (see *Radio-activity*) may be, and is often, used for therapy in place of radium. It is pumped away from the parent radium and dissolved in water, in which it is readily soluble. The activity of the emanation, however, quickly falls off owing to the rapidity of its decay. Initially, however, the activity is as high as that of the parent radium. If the application of a glass tube containing emanation solution is not delayed it may be used effectively in place of radium, the possible accidental loss of which is thus avoided, and in addition the availability of radio-active treatment considerably enhanced. Radio-active radiation is employed for much the same therapeutic purposes as X-rays, e.g. in certain cases of cancer and rodent ulcer, and among its successes is claimed the satisfactory breaking down of scars and adhesions. Its use is, however, limited to those cases in which the tube of radio-active material may be brought into actual contact with the affected part.

Ultra-violet Light.—The subject of radiology should not be dismissed without mention of the therapeutic uses to which electro-magnetic rays of slightly shorter wave-length than light are put. These rays are termed ultra-violet rays, and are produced in the ordinary electric arc between mercury or tungsten electrodes. The rays are readily absorbed by glass, but are trans-

mitted by fused quartz. Cases of lupus and kindred skin diseases are effectively treated by these rays. Cf. D. Arthur and J. Muir, *Manual of X-Ray Work*.

Radiometer, an apparatus invented by Sir William Crookes (about 1875). It consists of a glass bulb, which contains a small light cross with vertical vanes at the ends of the arms. The cross is pivoted on a steel point, and is capable of rotating in a horizontal plane under the action of heat or light rays. The vanes are metallically bright on one side and dull black on the other, and the bulb contains air or other gas at an extremely low pressure. When light rays fall on the vanes, they are absorbed, in the form of heat, by the black sides, but are reflected from the bright sides. The black surfaces thus become slightly warmer than the others, and when gas molecules collide with the vanes, those which impinge against the black surfaces are warmed and rebound with greater momentum. By the law of reaction an equal increase of momentum is communicated to the vanes, and the black surfaces are apparently repelled by the light, and rotation takes place. The speed of rotation varies with the degree of exhaustion of the bulb; at a certain stage the black surfaces move forward under the action of the radiation—an effect due to convection currents in the gas. As rarefaction proceeds, this forward motion slows, stops, then reverses, attains a maximum, slows, and finally stops, the gas having become too rarefied. When the radiometer is subjected to different sources of light, the speed of rotation of the vanes depends on the intensity of the incident light; the instrument may thus be used, in some sort, as a photometer. In the spectrum the speed of rotation increases as the radiometer is moved from the ultra-violet to the infra-red, and the instrument has been employed to investigate the distribution of heat in the solar spectrum.



Radiometer

Radish (*Raphanus sativus*), a well-known

cruciferous plant, cultivated in Britain since 1548. The tender leaves are used as a salad, the green pods as a pickle, and the succulent roots are much esteemed.

Radium (symbol, Ra; atomic weight, 226), an element discovered by M. and Mme Curie in a sample of pitch-blende from Joachimsthal. Radium is widely distributed, but in minute quantity. All uranium ores contain the element, and it has been found in the waters of mineral-springs and in many rocks and minerals. Its radio-active properties make its presence, even in minute quantity, easily detected. About 0.32 gramme of the element radium is present per ton of the element uranium in the ores. Radium and its compounds resemble very closely the alkaline earths, especially the element barium. Thus barium sulphate is sparingly soluble in water and acids; radium sulphate is even less soluble, being the least soluble sulphate known. Barium chloride is soluble in water, and crystallizes with two molecules of water of crystallization. Radium chloride is also soluble in water, and crystallizes with the same amount of water.

On account of the great similarity of the salts of barium and those of radium, they are somewhat difficult to separate; the bromides are more easily separated than the chlorides. These salts are less soluble in water and in hydrochloric and hydrobromic acids than those of barium, and can therefore be separated from the latter by fractional crystallization. The salts are colourless, but develop colour on standing. They are luminous in the dark, and they colour a non-luminous flame carmine-red. The metal has been obtained by electrolysis of the fused chloride. It is a white lustrous metal of melting-point 700°, and tarnishes in air, a nitride being formed. It decomposes water vigorously, hydrogen being evolved, and radium going into solution as the hydroxide. See *Radio-activity*; *Rays*, *Electric*; *Radiology*.

Radnor, or Radnorshire, an inland county of South Wales; served by the Cambrian and London & North-Western Railways; area, 471 sq. miles. The surface throughout is hilly, the highest summit of the Forest of Radnor reaching an elevation of 2163 feet above sea-level. The Wye is the principal river, and, with its tributaries the Elan, Ithon, Edwy, Arrow, and Somergil, &c., it abounds in fish. Another stream is the Teme, tributary to the Severn. Oats and wheat are the principal crops, but the chief dependence of the farmer is on the sheep and ponies reared on the pasture-lands. Large quantities of butter are made. The chief manufacture is flannel, but it is of no great extent. There are mineral-springs, especially at Llandrindod. Presteign is the county town. Pop. (1921), 23,528.

Radom, a district and town of Poland. The district has an area of 4700 sq. miles, and a population of about 1,200,000. Agriculture is the staple employment. The town is capital of the district, and stands on the Mlechna, and is served by the Ivangorod-Dombrova railway. There are tanneries, ironworks, and manufactures of agricultural implements and machinery. Pop. (1921), 61,630. The battle of Radom (European War) was fought by the Austrians and Russians between 25th and 28th Oct., 1914, when the Russians occupied the town and drove the Austrians back on Kielce, from which they again advanced after the Russian retreat of 1915.

Rae Bareilly, a district of India, in the Lucknow division of the United Provinces, traversed by the Ganges and the Sai, and by the Loni, a tributary of the Ganges. Rice is the principal crop. Area, 1750 sq. miles; pop. 1,200,000. The town is the district head-quarters, and stands on the banks of the Sai; served by the Oudh & Rohilkhand Railway. It is the chief commercial centre of the district, and has manufactures of cotton cloth and muslins. Pop. 16,000.

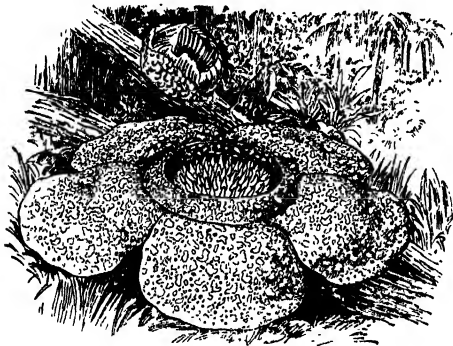
Raeburn, Sir Henry, Scottish portrait-painter, born at Edinburgh in 1756, died in 1823. The son of a manufacturer, he was bound apprentice to a goldsmith at the age of fifteen. He soon began to paint miniatures, and before long devoted himself entirely to portrait-painting, being practically self-taught. In 1778 he married a young and wealthy widow, and, with a view to improving in his art, repaired to London, afterwards (on the advice of Reynolds) spending two years in Rome. Returning in 1787, he established himself in Edinburgh, and was soon at the head of his profession in Scotland, having as sitters almost all the eminent Scots of his time and producing over 700 portraits. After 1810 he exhibited regularly at the Royal Academy (London), was elected an associate in 1812, and a full member in 1815. He was knighted by George IV in 1822. His portraits are distinguished by grasp of character, breadth and directness of treatment, and colour. The most representative collection of his work is in the National Gallery of Scotland.—Cf. Sir W. Armstrong, *Sir Henry Raeburn*.

Raff, Joachim, musical composer, born in Switzerland, of German parents, in 1822, died in 1882. He was encouraged by Mendelssohn and Liszt, and having gone in 1850 to live at Weimar, in order to be near Liszt, his opera, *König Alfred*, was first performed there at the Court Theatre. His *Dame Kobold*, a comic opera, was produced in 1870, but his reputation rests chiefly on his symphonies. He wrote also much chamber music of undoubted excellence.

In 1877 he was appointed director of the Conservatoire at Frankfort, where he died.

Raffles, Sir Thomas Stamford, English administrator, born in 1781, died 1826. He entered the East India Company's civil service, and in 1811, on the reduction of Java by the British, he was made Lieutenant-Governor of the island. In this post he continued till 1816, when he returned to England with an extensive collection of the productions of the Eastern Archipelago. The year following appeared his *History of Java*. Having been appointed to the Lieutenant-Governorship of Bencoolen, Sumatra, he went out in 1818 to fill this post, founded the settlement of Singapore, and returned to Europe in 1824.—Cf. D. C. Boulger, *The Life of Sir Stamford Raffles*.

Raffie'sia, a genus of parasitical plants, ord. Rafflesiaceæ, of which the chief species is *R.*



Rafflesia Arnoldi. Bud and Flower

Arnoldi. This gigantic flower, one of the marvels of the vegetable world, was discovered in the interior of Sumatra by Sir T. Raffles and Dr. Arnold. The whole plant consists of little else beyond the flower and a system of fine threads, which traverse the root-plant like the hyphæ of a fungus. The perianth or flower forms a huge cup reaching a width of 3 feet or more; it weighs from 12 to 15 lb., and some of its parts are $\frac{1}{2}$ inch in thickness. It is fleshy in character and appearance, remains expanded for a few days, and then begins to putrefy, having quite the smell of carrion, and thus attracting numerous insects.

Ragatz, a town of Switzerland, canton of St. Gall, situated at the junction of the Tamina with the Rhine, 1700 feet above the sea, and connected by railway with Zurich and Coire. It is much resorted to both for its beautiful scenery and its mineral-waters. There is a bathing establishment near the springs, erected in 1704. The temperature of the water is 97°–100°, and it is impregnated with carbonate of

lime, magnesia, and salt. The village of Pfäfers lies 2 miles south of Ragatz at a height of 2606 feet. The permanent population is about 2000, but the place is visited annually by about 30,000 invalids.

Ragee (*ra-gē'*), or **Ragi**, an Indian grain (*Eleusine coracana*), very prolific, but probably the least nutritious of all grains. In the form of cake or porridge it is the staple food of the poorer classes in Mysore and on the Nilghiris.

Ragged Schools, institutions supported by voluntary contributions, which provide free education, and in many cases food, lodging, and clothing for destitute children, and so aid in preventing them from falling into vagrancy and crime. These schools differ from certified industrial schools in that the latter are for the reception of vagrant children and those guilty of slight offences; but the two institutions are frequently combined. The idea of forming such schools was due to a Portsmouth cobbler, John Pounds, who about 1819 began to take in the ragged children of the district in which he lived and teach them while he was at work. The name of Dr. Guthrie of Edinburgh is prominent among those who developed this scheme of rescue. The name *ragged schools* was first adopted in 1844. The Acts of 1870 and 1871 having introduced compulsory school attendance in England, many of the ragged schools were absorbed by the public schools. The Ragged School Union was founded in 1844, but since 1914 it has been known as The Shaftesbury Society and Ragged School Union.

Raglan, Fitzroy James Henry Somerset, Lord, born 1788, died 1855. The youngest son of Henry, fifth Duke of Beaufort, he entered the army in 1804; was attached in 1807 to the Hon. Sir Arthur Paget's embassy to Turkey; and the same year served on Sir Arthur Wellesley's staff in the expedition to Copenhagen. He acted as military secretary to the latter during the Peninsular War, in which he greatly distinguished himself at the capture of Badajoz. At Waterloo he lost his right arm. From 1816 to 1819 he acted as secretary to the embassy at Paris, and from 1819 to 1852 as military secretary to the Duke of Wellington. In 1852 he was made Master-General of the Ordnance, and was elevated to the House of Peers as Baron Raglan. On the outbreak of the Crimean War he received the appointment of commander of the forces, and remained in charge of the campaign till his death. See *Crimean War*.

Rags are worn or torn remnants of textile material. They form an article of commerce, woollen rags being of more value than linen or cotton. Silk rags are the least useful. In the preparation of rags for industrial purposes they are first disinfected, then sorted, bleached,

and reduced to pulp. From woollen rags 'shoddy' and other coarse materials are made. Linen and cotton rags were until the middle of the nineteenth century the only materials from which paper was made. For this purpose they have now been largely supplanted by esparto grass and wood-pulp; but they are still used for the manufacture of special kinds of paper, e.g. for bank-notes, &c.

Ragstone, a sedimentary flaggy rock, so named from its rough fracture. It is used for a whetstone without oil or water for sharpening coarse cutting tools. The term is also applied to certain impure limestones, such as the Jurassic Coral Rag and the Cretaceous Kentish Rag.

Ragu'sa (Slav. *Dubrovnik*), a seaport of Yugoslavia, in Dalmatia, on a peninsula in the Adriatic, is surrounded by old walls flanked with towers, and has several forts. Ragusa is supposed to have been founded by Greeks in 589 B.C. Falling successively under the dominion of the Romans and the Greek emperors, it finally asserted its independence, which it long maintained, though having to pay tribute to one or other of its powerful neighbours. In 1814 it came into the possession of Austria. Pop. 12,000.

Ragusa, a town of Sicily, on the River Ragusa; served by railway from Syracuse (70 miles). It manufactures cottons, macaroni, and cheese, and has a trade in corn, wine, and oil. Ragusa is identified with the ancient *Hybla Heræa*. Pop. 40,000.

Ragwort, or **Ragweed**, the popular name of various species of composite plants of the genus *Senecio*, found in Britain, so called from the ragged appearance of the leaves. The common ragwort (*S. Jacobæa*) is a perennial with golden-yellow flowers, growing by the side of roads and in pastures. It is a coarse weed, refused or disliked by horses, oxen, and sheep, but eaten by hogs and goats.

Raibolini (ri-bo-lē'nē), Francesco di Marco di Giacomo, usually called *Francesco Francia*, a famous Italian painter, engraver, medallist, and goldsmith, was born at Bologna about the middle of the fifteenth century, died 1517. He excelled particularly in Madonnas, and executed a number of admirable frescoes in the church of St. Cecilia at Bologna, but his most famous work is an altarpiece exhibiting the *Madonna, St. Sebastian*, &c., in the church of St. Giacomo Maggiore in the same city. Three works of his are in the British National Gallery. He was also celebrated as a portrait-painter. Raibolini had a son, Giacomo, who studied under him, and acquired considerable celebrity.

Raichur, a district and town of Hyderabad, India. The district is in the Gulbarga division,

and is traversed by the Kistna. Native food grains, cotton, and oil-seeds are produced. Area, 6800 sq. miles; pop. 995,000. The town is the head-quarters of the district, and is the junction of the Madras and Great Indian Peninsula Railways, 350 miles from Madras and 444 miles from Bombay. Industries include cotton-pressing, tanning, and distilling. Pop. 25,000.

Raikes, Robert, British philanthropist, born at Gloucester 1735, died 1811. He was proprietor of the *Gloucester Journal*, and originated the system of Sunday-schools by gathering together a number of street children for secular and religious training.

Rail, the common name of birds belonging to the Rallidæ, a family of the crane, &c., order (Gruiformes), comprehending the rails proper (Rallus), the coots, water-hens, and crakes. They are characterized by possessing a long bill, which is more or less curved at the tip and compressed at the sides, by having the nostrils in a membranous groove, the wings of moderate length, the tail short, the legs and toes long and slender, and the hind-toe placed on a level with the others. Most of the members of the family are aquatic or frequent marshes; but some, as the crakes, frequent dry situations. The principal species of the genus *Rallus* are the water-rail of Europe (*R. aquaticus*), about 11 inches in length, of an olive-brown colour, marked with black above, and of a bluish-ash colour beneath, with white transverse markings on the belly, much esteemed for the table; the Virginian rail of America (*R. virginianus*), somewhat smaller than the water-rail of Europe; and the king rail or freshwater marsh-hen (*R. elegans*), about 20 inches long, which inhabits the marshes of the southern states of America. The land-rail, so named, is the corn-crake (*Crex pratensis*). See *Corn-crake*.

Railways, British: Organization and Administration.—Before dealing with the organization of British railways as existing to-day, it is essential to note the progress which has been made in transportation by rail during the last fifty or sixty years, and which has made such detailed organization necessary. That the progress has been rapid is apparent when it is stated that in 1868 the total mileage of railway track in Great Britain was 20,102, and the capital sunk £484,536,878, whereas to-day there are 34,931 miles of railway track excluding sidings open to traffic, which, together with rolling stock and miscellaneous property, represents an immobilization of capital amounting to £1,282,490,131.

Board of Directors.—The policy and administration of a British railway are vested in a board of directors appointed by the shareholders. The full board of directors meets at regular intervals, and when required. In addition ther

is a number of directorial committees selected from the full board, whose function is to confer with the head of the department whose business appertains to the committee concerned.

The General Manager.—The responsible officer for the executive administration is the general manager. Modern railways are large concerns, and it is not practicable for the general manager to supervise personally the detailed work of all departments, but he is recognized as the connecting-link between them and the board of directors.

The organization generally in force to-day follows much the same lines on every railway, and is explained by the accompanying chart.

The general duties of the various officers can be more or less definitely gathered from their designations, but the following sets out briefly the functions of the more extensive departments, and also their relations one to the other.

The *secretary* submits all matters to the board of directors, and is responsible for keeping a record of the deliberations of the board. Through the medium of the registrar, he is responsible for all stock and share work.

The *chief engineer* is charged with the duty of seeing that existing lines and works are properly maintained, and with the construction of new works; he is also responsible for the maintenance of the signalling arrangements.

The *chief mechanical engineer* is charged with the designing and construction of all classes of rolling stock, and with keeping it in a fit state of repair; he is also responsible for the provision of the necessary locomotive power to meet the requirements of the traffic officers.

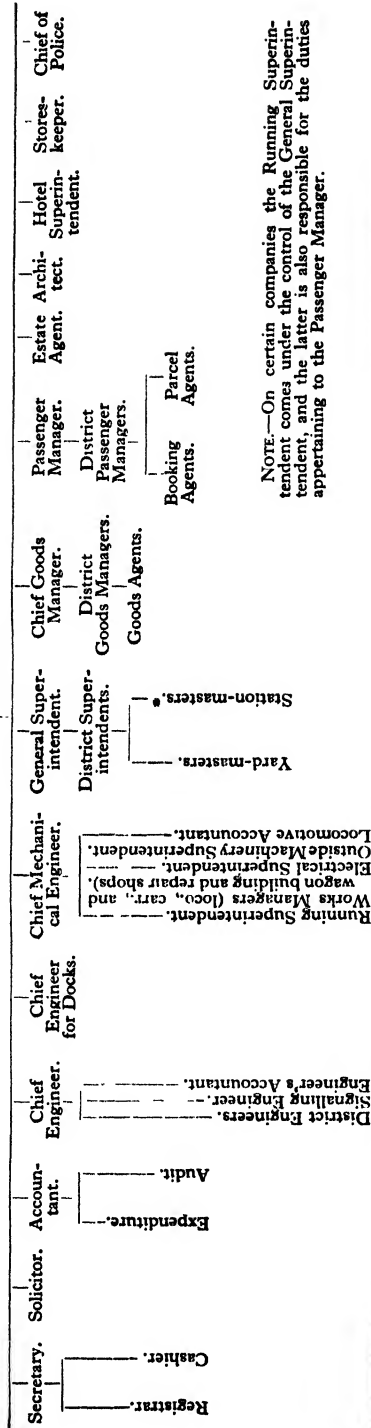
The *general superintendent* arranges and controls all passenger and freight train services, and also controls wagon stock and coaching stock in addition to supervising a large outdoor staff engaged in working and handling traffic.

The *chief goods manager* has for his principal functions the securing of goods train traffic and the charging for the conveyance of same. He is in close touch with the outside public on all matters relating to the carriage of traffic by goods trains.

The *passenger manager* has functions in respect of traffic by passenger trains which are analogous to those of the chief goods manager as regards traffic by goods trains.

Ministry of Transport Act, 1919.—Upon the outbreak of the European War in Aug., 1914, when military claims on transport became more imperative than commercial, the railways were taken over and placed under the control of the Government, and remained so until Aug., 1921. This was purely a war measure, as the railways continued to be worked by the companies, the control being exercised through a committee con-

DIRECTORS.
GENERAL MANAGER.



NOTE.—On certain companies the Running Superintendent comes under the control of the General Superintendent, and the latter is also responsible for the duties appertaining to the Passenger Manager.

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sisting of the general managers of the principal companies; and during the period of control the 1913 net revenue of the companies was guaranteed by the Government.

In Aug., 1919, the Ministry of Transport Act was passed. The purposes of this Act were to extend the period of Government control to cover the transition period from war to peace conditions, to improve the means and facilities for transport, and to afford time for the consideration and formulation of the future policy to be followed in regard to the working of railways. Practically the whole of the powers which had been vested in the Board of Trade were transferred to the Ministry of Transport, and, in addition, wide powers were conferred on the Minister appertaining to the control and general working of the railways. Amongst these may be mentioned the power to purchase privately-owned railway wagons, and also the regular rendering to the Ministry of elaborate statistical information. Mention should also be made of the setting up of the Rates Advisory Committee for the purpose of assisting the Minister to deal with all questions affecting the revision of rates and charges.

The Government control of railways ceased on 15th Aug., 1921, and with the expiration of the 1919 Act the railways reverted to their pre-war

condition. It was, however, very evident that, with the improved conditions of service and increases in rates of pay which had been granted during the period of control, and without corresponding increase in rates and charges, some reorganization of the railways was inevitable to restore their former financial stability, and the Railways Act of 1921 was introduced with this object in view. Broadly, the Act may be divided under the following salient heads from a reorganization point of view: (a) The grouping of the railway systems of Great Britain. (b) The establishment of a Rates Tribunal with new machinery for fixing and adjusting rates, fares, and charges, with a view to the securing of a standard minimum revenue for all companies. (c) Setting up of new machinery for the adjustment of questions relating to rates of pay, hours of duty, and other conditions of service of railway employees. In addition, the Act sets out the basis of settlement of the companies' claims against the Government for compensation, and also confers on the Minister certain powers with regard to the working of railways.

Dealing with the above three heads *seriatim*: (a) provides for the railway systems of Great Britain being amalgamated into four main groups, particulars of the constituent companies of which are given below:

Group.	Route Mileage.	Track Mileage.	Capital. £.	Constituent Companies.
Southern	1,953	3,894	152,594,997	L. & S.W. L.B. & S.C. South-Eastern. I.C. & D. S.E. & C. Railway Companies' Managing Committee.
Name of new company—Southern				
Western	3,258	5,597	135,993,422	G.W. Barrv. Cambrian. Cardiff Railway Company. Rhymney. Taff Vale. Alexandra (Newport and South Wales) Docks and Railway Company.
Name of new company—Great Western				
North-Western, Midland, and West Scottish }	6,612	12,914	527,234,154	L. & N.W. Midland. L. & Y. North Staffs. Furness. Caledonian. G. & S.W. Highland.
Name of new company—London, Midland, & Scottish				
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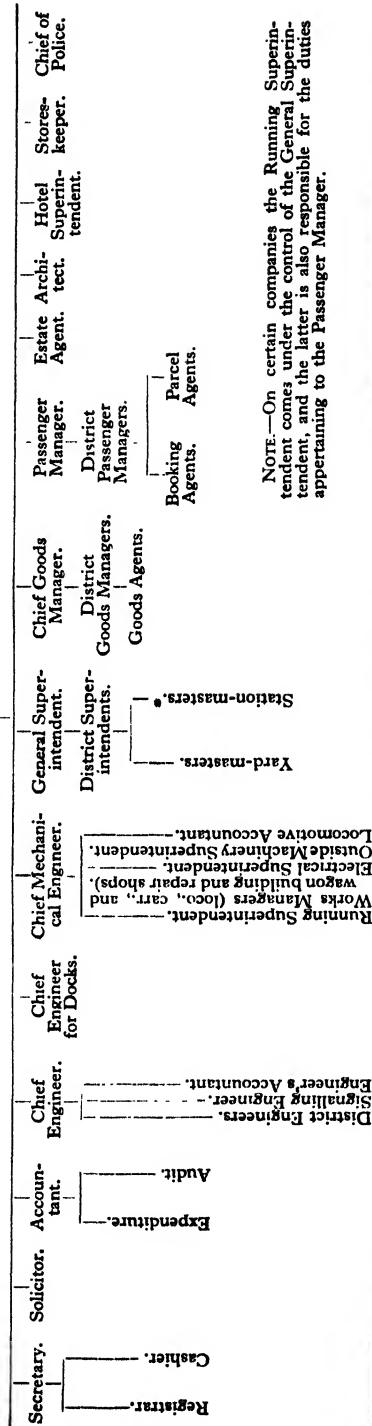
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Territory Served: Southern Railway.—The counties south of the Thames extending westward to Cornwall and Devon. *Great Western Railway.*—South-western counties; also large portion of South Wales. Extends to North Wales and Cheshire. *London, Midland, & Scottish Railway.*—Practically the whole of the Midlands, North Wales, and north-western counties of England; also Western and Northern Scotland. *London & North-Eastern Railway.*—Eastern, midland, and north-eastern counties of England; also Eastern and Northern Scotland.

(b) The Act provides for the establishment of a *Rates Tribunal* consisting of three permanent members, one an experienced lawyer, another versed in commercial affairs, and the third one versed in railway matters, who will be an overriding authority in respect of railway rates and charges. In addition, provision is made for the formation of two *panels*. One consists of thirty-six persons, twenty-two of whom will be representative of trading interests, twelve representative of the interests of labour, and two representatives of agricultural and horticultural interests. This is known as the 'general panel'. The other panel, known as the 'railway panel', consists of twelve members, eleven being nominated by the Minister of Transport after consultation with the Railway Companies' Association, and the remaining member, who is nominated by the Minister of Transport, will represent concerns which are not parties to the Railway Companies' Association.

(c) Provides for the establishment on each railway company of one or more *councils* consisting of representatives of the railway company and representatives of the men. It is also laid down that all questions relating to rates of pay, hours of duty, or other conditions of service of employees, shall, in default of agreement between the railway companies and railway trades unions, be referred to the Central Wages Board or, on appeal, to the National Wages Board.

Railways, Electrification of. By this phrase is usually meant the substitution of electric power for steam power as the propulsive force on railways. Few railways have been built to use electric power from the day they were opened.

The electric drive is applied on three distinct systems, the 'direct-current system', the 'single-phase system', and the 'three-phase system'.

In the direct-current system the electric motors on the trains are worked with direct-current electricity; in the second, with single-phase alternating current; and in the third, with three-phase alternating current.

Electric power is generated at large central power-stations from coal or from water power. The electrical energy leaves the power-station

by transmission lines as high-tension single-phase, or three-phase, alternating current. The electrical pressure at which these transmission lines are worked is often very high, and ranges from 5000 volts to 150,000 volts. The electrical energy at this pressure is transformed by means of 'transformers' to a lower pressure. If the railway is a single-phase or three-phase one, the electrical energy, at the lower pressure at which it is delivered by the transformers, goes straight to the track conductors and thence to the train motors. If the railway is a direct-current one, the low-pressure alternating current is converted in a machine called a 'rotary converter' into direct-current, the form in which the electrical energy can be used by the direct-current motors.

The current is supplied to the trains by one of two systems—the 'overhead system' or the 'third-rail system'.

On the overhead system an electric wire is run above each of the railway tracks, much as the tramway wire runs over the tramway tracks on street tramways. Some of the railway carriages are fitted with collecting devices called 'pantographs', which make contact with the overhead 'live wire', and current passes via these pantographs from the live wire to the electric motors on the train. The circuit is completed by the railway track rails. These rails are connected together with thick copper conductors at each joint, and are thus made electrically continuous. The current, after going through the motors, comes back by this return circuit. The return circuit is always in the neighbourhood of earth potential, and is consequently not dangerous to touch. This system is used both for direct- and for alternating-current railways. If the three-phase system is used, there must be *two* separate overhead wires over each track.

The other method is the third-rail system. A third-rail is run alongside the two railway running rails, and is supported on electrical insulators.

This rail—the conductor rail—is at a high potential relative to earth, and forms the positive conductor of the circuit. The negative conductor is, as before, the bonded running rails. A collector shoe is attached to the carriages, instead of a pantograph, and runs along the surface of the third-rail. The collector shoe is connected to the positive terminal of the motor, and the negative terminal of the motor is connected to the bonded running rails, and the circuit through the motor is thus completed. This system is used exclusively for direct-current lines. The overhead-wire system is used in England on the London, Brighton, & South Coast Railway, the North-Eastern Railway, and the Heysham-Morecambe Railway; the third-rail

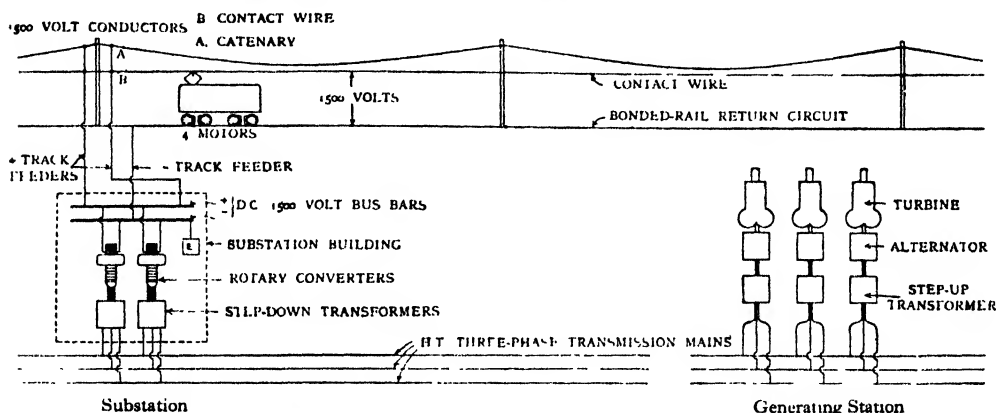
system is used by the Underground Electric Railways of London, the Liverpool & Southport line, the North-Eastern Railway Company, the London & South-Western Railway Company, and the London & North-Western Railway Company.

The electrical pressures of the overhead wire vary from about 6000 volts on the London, Brighton, & South Coast Railway to about 15,000 volts on Continental and United States railways. The electrical pressure of the third-rail is usually about 800 volts, but third-rails

The electrification of a line obviously costs a large sum of money. How is this justified? Its justification depends on the following factors, among others:

1. Broadly speaking, to haul a given train at a given speed, half the coal which a steam engine requires is sufficient if the train is hauled electrically.

2. The cost of repairs and renewals is very much less on an electric railway, because the electric locomotives or motor-coaches (the most expensive items to maintain) have only electric



Diagrammatic Lay-out of 1500-volt Direct-current Electric Railway

of 2400 volts have been tried in America. A 1500-volt third-rail has been tried on the Lancashire & Yorkshire Railway, apparently with success. The highest pressures of overhead wires, when used for direct current, are about 5000 volts.

The trains may be driven in many ways. The motors may be placed to drive the axles of alternate carriages, and designed so that the motors on the 'motor-coach' are sufficiently powerful to drive the coach itself, plus one trailer-coach. This arrangement is called the 'multiple-unit system'. The motors are connected so that they can be controlled from either end of the combined unit. The driver has a handle like an ordinary tramway-driver's handle. Two, three, four, or five of these 'units' may be coupled together, and a four, six, eight, ten, &c. coach-train formed. The wiring is arranged so that this combined train can be driven from either end. This system has great advantages where a heavy suburban traffic is run, as it reduces shunting operations at the busy termini.

The other system of haulage is by electric locomotives. The largest steam locomotives which exist in Great Britain have a capacity of from 1000 to 1500 h.p., whereas electric locomotives can be built for a capacity of 5000 h.p.

motors and electrical apparatus, which do not very easily go wrong; the boiler alone of the steam locomotive is very expensive to maintain. Before the European War the cost of maintaining an electric locomotive was about £30 to £40 per annum, whereas the cost of maintaining a steam engine of the 'Atlantic' type was about £500 per annum.

3. The hauling power of the electric locomotive is much greater than that of the steam one.

4. The electric locomotive and also the motor-coach are always ready for work, and do not require attention when they are not being used.

These and other economies often make the cost of running a train a mile electrically about one-third to one-half of the cost of running the same train a mile by steam. See *Electric Traction*.—BIBLIOGRAPHY: E. Wilson and F. Lydall, *Electrical Traction*; E. P. Burch, *Electric Traction for Railway Trains*; H. F. Parshall and H. M. Hobart, *Electric Railway Engineering*; A. T. Dover, *Electric Traction*; *Railway Mechanical Engineering* (The Gresham Publishing Co.)

Rainbow, a bow, or an arc of a circle, consisting of all the prismatic colours, formed by the refraction and reflection of rays of light from drops of rain or vapour appearing in the part of the heavens opposite to the sun. When the sun

is at the horizon, the rainbow is a semicircle. When perfect, the rainbow presents the appearance of two concentric arches; the inner being called the *primary*, and the outer the *secondary* rainbow. Each is formed of the colours of the solar spectrum, but the colours are arranged in the reversed order, the red forming the exterior ring of the primary bow, and the interior of the secondary. The primary bow is formed by the sun's rays entering the upper part of the falling drops of rain, and undergoing two refractions and one reflection; and the secondary, by the sun's rays entering the under part of the drops, and undergoing two refractions and two reflections. Hence, the colours of the secondary bow are fainter than those of the primary. The common centre of the two bows is exactly opposite to the sun, and they have radii of about 41° and 52° . Rainbows are sometimes produced by the sun's rays shining on the spray of cascades, fountains, &c., and then a whole circle can frequently be seen. A broken rainbow is generally due to the field not being filled with falling rain, but it will also result from the sun being invisible from part of the field, its rays being intercepted by cloud. The moon sometimes forms a bow or arch of light, more faint than that formed by the sun, and called a *lunar rainbow*. A *spurious* or *super-numerary* rainbow is a bow seen in connection with a fine rainbow, lying close inside the violet of the primary bow, or outside that of the secondary one. Its colours are fainter and more impure the farther they proceed from the principal bow, and finally merge into the diffused white light inside the primary bow, and outside the secondary.

Rainfall is one of the processes in a constant cycle of changes whereby the water with which our globe's exterior is provided is alternately suspended in the air, and returned to the oceans and land surface. The heat of the sun is instrumental in evaporating it from the liquid form and adding it as aqueous vapour to the atmosphere, and there are various factors which operate to effect its condensation as cloud and rain. It may happen, but not very commonly, that a mass of air may be cooled by coming into contact with a ground surface colder than itself, or that a stationary mass of air may be cooled by radiation, and in either case some of the moisture be condensed and fall as rain. In by far the greater number of cases, however, the cause of rain is an upward motion of the air. As a general rule the air temperature diminishes with altitude above the earth's surface. This is so in the first place because the sun's direct rays have little heating effect on the air. They travel through it, but are absorbed by and warm the earth, which then returns to the air

overlying it, as dark heat, some of the radiation received. But if a mass of air ascends, it is cooled, even irrespective of the fact that it meets with colder air above. As it rises the pressure on it falls, since pressure necessarily diminishes with height in the atmosphere. Consequently it expands, and when a gas expands it thereby falls in temperature.

There may be distinguished three ways in which air is caused to ascend, with resultant cooling and possibly rainfall. These are described as (1) convectional, (2) cyclonic, (3) orographical. Convectional rainfall is produced by a mass of air near the earth's surface being raised by the effect of the sun's heat to a temperature higher than the surrounding air. At this place there will be formed a steep temperature gradient in the vertical direction, with consequent instability, and an upward current of air will be originated. If the action is intense, there may be not only rain but considerable electrical disturbance and thunderstorm. This, of course, happens mainly in summer-time. Cyclonic rain is more frequent in the British Isles in winter, and is due to the cyclonic depressions which pass near the islands from the Atlantic. The rain occurs mostly at no great relative distance from the centre of the depression, and the condensation is largely a result of the upward movement of the air which always takes place in the central part of a low-pressure system. Orographical rainfall, as the name implies, is caused by the action of mountains. On the windward side of a mountain the approaching wind is deflected upwards, and, under the requisite conditions of humidity and temperature, cloud or rain is produced. This action will frequently be seen when the mountain-side is enveloped by cloud down to a particular level. The cloud will be observed to be all the time rising up the mountain-side, yet its lower border remains at the same position, cloud being continually formed in the place of that which travels upward. Or again, the cloud may be formed just at the top level, and appear as a cap to the mountain summit (e.g. 'table-cloth' on Table Mountain). The prevalence of orographical rainfall is illustrated by the high rainfall of our western mountainous districts, where the moisture of the predominant westerly winds is deposited, compared with the lower rainfall of the more level eastern districts. A case essentially resembling orographical rainfall occurs frequently when a warm and moisture-laden wind meets a colder current. The warm air naturally tends to rise over the colder, which passes beneath, or 'undercuts' it. Owing to the ascent the warm air expands and discharges its moisture. The cold wind thus plays the same part as did the mountain in the previous case. It has

been mentioned that cyclonic rains occur here mainly in the winter. In the spring months cyclonic depressions are less frequent, and the weather becomes drier. With the summer the rainfall increases, owing to the frequency of convectional rains. There is again a drier period about September, because the sun's power of causing convectional rain has diminished, and the cyclones have not resumed their winter prevalence. The mixing of masses of warm and cold air is sometimes given as a cause of rain. It is possible for two such masses, each above its dew-point, to form a combination which would be below its dew-point, and therefore deposit some moisture. But the amount would be extremely small, so that, while such action may occasionally take place, this is of little importance as a factor in rainfall production. See *Climate*; *Meteorology*.

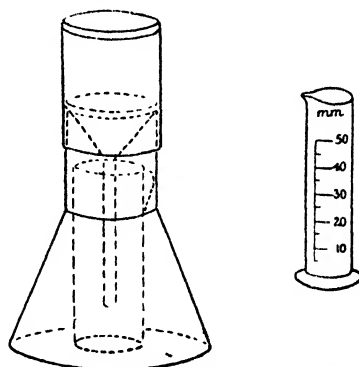
Under different conditions raindrops vary in diameter from about $\frac{1}{160}$ th to about $\frac{1}{8}$ th of an inch. It has been shown that drops larger than the latter size cannot exist, as they break up into smaller drops. Even drops of this size do not fall, but remain suspended, if placed in a current travelling upward at the rate of about 25 feet per second. Such an upward velocity in the atmosphere seldom occurs, but smaller drops would be prevented from falling by a slower ascending current. No doubt rain is often formed and is in this way prevented from reaching the earth. In other cases rain which has fallen some distance may pass into a drier stratum and be again evaporated before completing its descent.

The descent to the ocean of the water which results from rainfall, in the form of rivers and streams traversing the land surface, means the liberation of a large amount of energy which may to a considerable extent be drawn upon for useful purposes. The energy of running water has long been utilized directly by means of water-wheels for driving machinery in mills, &c. It is now being made use of, and will doubtless be much more used in the future, as a source of electrical energy. This can be conveniently transmitted as such over great distances, and made available for mechanical and other purposes where it may be required. The original source of this energy is of course to be found in the action of the sun's heat, which had the effect of lifting all this water against the earth's gravitation from the ocean or land surface into the atmosphere.

The presence or absence of vegetation may possibly have considerable influence on the rainfall of a district. Land devoid of vegetation readily absorbs the solar radiation. The air in contact with it also becomes heated, with the result of increasing its capacity for containing moisture, and thereby lessening precipitation. On the other hand, land covered with an abundant

vegetation has its soil kept cool, and thus assists in condensation. The influence of forests on rainfall is still a matter of dispute, but on the whole it seems certain that forests increase the precipitation of a district. The proximity of warm ocean currents tends to increase, and that of cold currents to decrease, rainfall. Although more rain falls within the tropics in a year, yet the number of rainy days is less than in temperate climes. Thus in an average year there are 80 rainy days in the tropics, in the temperate zones about 160. Cherrapunji, in the Khasia Hills of Assam, with an average of 426 inches in the year, is one of the rainiest stations on the globe. It is stated that on some mountains in the Hawaiian Islands this average is even exceeded. Maps showing rainfall are given under *Australia*, *England*, *Geography*, *India*, *Ireland*, &c.—BIBLIOGRAPHY: M. Salter, *Rainfall of the British Isles*; *British Rainfall* (Meteorological Office).

Rain-gauge, an instrument for measuring rainfall. Rainfall is estimated by the depth to



Rain-gauge and Measuring-glass

which a level surface would be covered by the water which falls upon it, supposing that none flows away or is evaporated. If the fall were uniform over a certain area, the size of that area would obviously be of no moment, as the depth of water would be everywhere the same. The simplest kind of rain-gauge would be a cylindrical vessel or jar, and the rainfall could be measured by merely inserting a graduated stick vertically into it, and reading off the depth of the contained liquid. But in practice it is necessary to adopt precautions against evaporation, and also means to evaluate more accurately the amount of water collected. In its ordinary form the rain-gauge has a removable conical funnel which collects the rain. Beneath is a cylindrical vessel firmly fixed in the ground. Inside this vessel is placed a can or bottle as receiver. The funnel terminates in a narrow

tube down which the collected rain flows into the receiver. Every twenty-four hours, if daily records are made, the funnel is removed, the receiver taken out, the water poured from it into a graduated measuring-glass, and the exact quantity noted.

The type of rain-gauge most commonly used has a funnel of 5 inches diameter, but at fully equipped observatories 8-inch gauges are generally employed. It will be understood that each size of gauge collects a definite volume of water for any specified rainfall, e.g. a rainfall of .10 inch. In this country it has been usual to estimate rainfall in inches, registering to two decimals of an inch. Now the metric units are largely adopted officially, and the rainfall recorded in millimetres and tenths.

Rain-gauges are constructed generally of copper, which is almost the only metal capable of withstanding satisfactorily the deteriorating effects of town air, but where the air is purer galvanized iron or zinc may be used.

Self-recording rain-gauges are of advantage as giving a continuous record of the rainfall, showing the amount of the fall for each hour or shorter period.

Rain Tree (*Pithecolobium saman*), a leguminous tree of tropical America, now largely planted in India for the shade it furnishes, and because it flourishes in barren salt-impregnated soils, as well as for its sweet pulpy pods, which are greedily eaten by cattle. Another species, *P. dulce*, has also been introduced into India, its pods also being edible.

Rainy Lake, or **Réné Lake**, a body of water forming part of the boundary between Minnesota and Canada. It is about 50 miles long, and of irregular breadth; receives the waters of numerous small lakes from the east and north-east, and empties itself by Rainy River, about 90 miles long, into the Lake of the Woods.

Raipur (rī-pōr'), a district and town in the Chhattisgarh division of the Central Provinces, India. The district occupies the upper basin of the Mahanadi, by which and by the Seonath it is traversed. The trunk line of the Bengal-Nagpur Railway passes through and has a length of 60 miles within the district, with two branches from the chief town. Rice is the staple crop. Area, 9780 sq. miles; pop. 1,250,000. The town is the head-quarters of the district and also of the division, and has a flourishing trade in lac, cloth, gold and silver, cotton, and grain. Pop. 35-36,000.

Raisins, the dried fruit of various species of vines, comparatively rich in sugar. They are dried by natural or artificial heat. The natural and best method of drying is by cutting the stalks bearing the finest grapes half through when ripe, and allowing them to shrink and

dry on the vine by the heat of the sun. Another method consists in plucking the grapes from the stalks, drying them, and dipping them in a boiling lye of wood-ashes and quicklime, after which they are exposed to the sun upon hurdles of basket-work. Those dried by the first method are called raisins of the sun or sun-raisins, muscatels, or *blooms*; those by the second, *lexias*. The inferior sorts of grapes are dried in ovens. Raisins are produced in large quantities in the south of Europe, Egypt, Asia Minor, California, &c. Those known as Malagas, Alicantes, Valencias, and Denias are well-known Spanish qualities. A kind without seeds, from Turkey, is called *sultanas*. The Corinthian raisin, or currant, is obtained from a small variety of grape peculiar to the Greek islands. A variety is exported from Australia.

Rajah, or **Rājā** (Skt. *rajan*, king; Lat. *rex*), in India, originally a title which belonged to those princes of Hindu race who, either as independent rulers or as feudatories, governed a territory; subsequently, a title given by the native Governments, and in later times by the British Government, to Hindus of rank. It is now not infrequently assumed by the zemindars or landholders, the title *Mahārājah* (great rajah) being in our days generally reserved to the more or less powerful native princes. The feminine title is *rancee*.

Rajpūt. The Rajpūts or Kshattriyas (Chattries) are, as being the fighting class, second in order of importance in the Hindu caste system, in which the Brahmans or priests hold the first place. The origin of the Rajpūts is vague, but their history goes back to the B.C. period of our era, when India was overrun by hordes of fair-skinned Aryans from the north-west. The original inhabitants of India were what are now known as Dravidians, and were stunted men of dark colour and flat features; they are found now only among some of the jungle tribes of Central and Southern India. These aboriginal Dravidians were conquered by the Aryans, who took their country and sat down to enjoy themselves. In the natural course of events the aborigines became the hewers of wood and drawers of water of our own Biblical story, while the conquering Aryans evolved themselves into three essential classes: (1) priests (Brahmans); (2) warriors and administrators (Kshattriyas); (3) traders, money-lenders, and agriculturists, putting the rightful owners of the soil into a further class as servants and slaves. The kings and princes required guards and soldiers for their protection, and these they naturally chose from their friends and relations; thus arose the name Kshattriya — 'those connected with royalty' — or Rajpūt — 'those of royal descent'.

In those far-off days it was considered advisable for ministers of state, both civil and military, to have a long pedigree, so the Kshattriyas invented a genealogy, one division fixing on the sun as their ancestor, while the second division had to be content with the moon. In course of time these main divisions broke up into various clans, of which thirty-six claimed to be of royal origin. Many of these clans exist to the present day, and are known as the royal races of Rajpúts. However much one may be inclined to disbelieve the mythical origin of the Rajpút, it is quite evident that he is of very ancient lineage, and, as a class, the Rajpúts insist on this, one of their prevailing characteristics being pride of race and family. In earlier days the Rajpúts formed—and to a certain extent still form—a military aristocracy of a feudal character; they are brave and chivalrous, keenly sensitive to an affront, and very jealous of the honour of their women. They are frugal in their manner of living, though excessively extravagant on such occasions as a marriage in the family. In religious beliefs they are second only to the priestly Brahmins, and are therefore very high-caste Hindus. Beef is abhorrent to them, and they eat very little meat of any kind. Their food must be cooked personally or by a Brahman, and they are very particular about ceremonial purity.

Generally speaking, the Rajpúts of Rájputána rank higher than, and are looked up to by, those from other parts of the country. In Rájputána, where Rajpúts have lived in a practically independent state for centuries, the blood is purer, while in other parts of India the race has apparently multiplied to a far greater extent than is warranted by the birth-rate. Rajpúts enlist in considerable numbers in the Indian army, both in the cavalry and infantry, and there are seven regiments entirely composed of them. Like other Hindus, the Rajpúts burn their dead, and at one time practised female infanticide and suttee (widow-burning). See *Rájputána*.

Rájputána, an agency of India comprising twenty native states and chieftainships as follows:

Alwar.	Jhelwar.
Bikaner.	Koah.
Bharatpur (Bhurtpore).	Karauli.
Banswara.	Kishangarh.
Bundi (Boondee).	Lawa.
Dholpur.	Parabgarh.
Dungarpur.	Sirohi.
Jodhpur.	Shapura.
Jaissalmer.	Tonk.
Jaipur.	Udaipur.

The principal states are treated separately.

Area, &c.—The total area, excluding the enclave Ajmer (q.v.), which is entirely a British province, is 128,897 sq. miles; pop. (1921), 9,857,020 (or 76 per square mile).

Towns.—Jaipur, Alwar, Bikaner, Udaipur, Bharatpur, Tonk, and Kotah, all state capitals.

Physiography.—Rájputána is traversed from south-west to north-east by the Arávalli Hills (Mount Abu, 5650 feet), which divide it into two zones. The north-western zone is sandy, ill-watered, and barren, excepting in the limited submontane area and towards the extreme north-east, near Delhi, where the Great Desert, which forms the Rájputána-Sind frontier, improves somewhat in conditions of fertility. Parallel ridges of sandhills cover the wastes, and there is only one river of any significance, the Luni, which has a course of 200 miles. The higher and more pleasant regions of the south-east comprise the second zone, where there is an abundant water-supply from an extensive river-system, and where woodlands are extensive. There are many artificial but no natural fresh-water lakes.

Social Conditions.—The principal language is Rájastháni, which is divided into about sixteen chief dialects and forms the everyday tongue of 75 per cent of the people. Hindus predominate, with Mahomedans second, and Jains third. The ruling family of Tonk are Pathan Mahomedans. 97 per cent of the Muslims are Sunni, 2 per cent Shiite, and the rest Wahábi.

Communications.—There are 630 miles of roadways in Rájputána, 307 miles of which are metalled. The Government of India operates the oldest and most important railway line, Rájputána-Malwa, which has a length of 720 miles within the state. The Indian Midland section of the Great Indian Peninsula Railway between Agra and Gwalior (19 miles through Dholpur state) is also Government controlled. Among the lines belonging to the native states are: the Jodhpur-Bikaner line (700 miles), starting from Marwar Junction on the Rájputána-Malwa system and running into branches at the Luni River; the Udaipur-Chitor (67 miles); the last 29 miles of the Bina-Guna-Baran line; and a metre-gauge line between Jaipur town and Sawai Madhopur via Nawai (73 miles).

Production.—Agriculture is the staple industry. Among crops are native food grains (including maize), cotton, rice (in certain districts), wheat, indigo, sugar-cane, poppy (for opium), tobacco, and oil-seeds (including mustard, castor, rape, and linseed). Fruits include the peach, tamarind, orange, guava, apricot, mango, and pomegranate. Ordinary household vegetables are also extensively produced. **Big Game.**—Lions existed in large numbers until quite recently, but have now been extirpated. Tigers, however, are plentiful, especially in the Arávallis; leopards are common, and sloth bears exist in the south-

east. Where both tiger and bear are found there are also large numbers of deer. Antelope and gazelles frequent the plains, and much small game is abundant.

Government.—Three Residents (Mewar, Jaipur, and West Rájputána) and three Political Agents are subordinate to the Political Agent at Abu, who represents the Indian Government, and the central authority is in the hands of the ruling prince or chief. Rájputána is, of course, in political relations with the Indian Government.

Rájsháhi, a division and district of Eastern Bengal, India. The division comprises the districts of Bogra, Dinápur, Jalpaiguri, Málida, Pabna, Rájsháhi, and Rangpur. Area, 18,000 sq. miles; pop. 10,200,000 (or 527 per square mile). The district has an area of 2590 sq. miles, and a population of 1,400,000. It slopes generally from west to east, and is traversed from north to south by the Eastern Bengal State Railway. Jute, rice, pulses, and silk are sent to Calcutta; rice is the staple crop, and true hemp (*Cannabis sativa*) is cultivated under Government control. The district is the unhealthiest, malaria-stricken region of Eastern Bengal. Rampur-Boalia is the head-quarters, and Nator the only other town of importance. The people are mainly Mahomedans, speaking the Northern Bengali dialect, Hindus being second in numerical strength.

Rakoczy (rä-kő'tsi), or **Ragotsky**, a famous princely family, now extinct in the male line, which from 1606 to 1676 ruled the principality of Siebenbürgen or Transylvania.

Râle, a bubbling sound produced in the bronchial tubes by the movement of mucus, which is formed as the result of some diseased condition of the lungs. Râles are heard, accompanying the breath sounds, at the surface of the chest, usually by means of a stethoscope (q.v.), and are of various types. The commonest forms are the bubbling, cavernous, consonating, clicking, crackling, crepitant, and dry râle. They aid the practised observer to diagnose the different diseased conditions which may affect the lungs.

Raleigh (ral'i), or **Ralegh**, Sir Walter, English navigator, warrior, statesman, and writer in the reigns of Elizabeth and James I, was born in 1552, died in 1618. He studied at Oxford, and at the age of seventeen he joined a body of gentlemen volunteers raised to assist the French Protestants. Little is known of his adventures for some years, but in 1580-1 he distinguished himself in the Irish rebellion, both by ability and severity. He became a favourite at court, a result which has been traditionally attributed to an act of gallantry, namely, his throwing his embroidered cloak in a puddle in

order that the queen might pass. In 1584 he obtained a charter of colonization and unsuccessfully attempted the settlement of Virginia in one or two following years. In 1584, also, he obtained a large share of the forfeited Irish estates, and introduced there the cultivation of the potato. Through the queen's favour he obtained licences to sell wine and to export woollens, was knighted and made Lord-Warden of the Stannaries or tin-mines (1585), vice-admiral of Devon and Cornwall, and captain of the queen's guard (1587). In 1588 he rendered excellent service against the Spanish Armada, and subsequently vessels were fitted out by him to attack the Spaniards. In 1592 he incurred the queen's displeasure by an amour with one of her maids of honour, the daughter of Sir Nicholas Throgmorton. Although he made the best reparation in his power, by marrying that lady, he was imprisoned for some months, and banished the queen's presence. To discover the fabled El Dorado or region of gold he planned an expedition to Guiana, in which he embarked in 1595, and reached the Orinoco; but was obliged to return after having done little more than take a formal possession of the country in the name of Elizabeth. In 1596 he held a naval command against Spain under Lord Howard and the Earl of Essex, and assisted in the defeat of the Spanish fleet and the capture of Cadiz. Next year he captured Fayal in the Azores; in 1600 he became Governor of Jersey. James I, on his accession in 1603, had his mind soon poisoned against Raleigh, whom he deprived of all his offices. Accused of complicity in Lord Cobham's treason in favour of Arabella Stuart, Raleigh was brought to trial at Winchester in Nov., 1603, found guilty of treason, and sentenced to death. He was, however, reprieved and confined to the Tower. Here he remained for twelve years, devoting himself to scientific and literary work. In 1616 he obtained his release by bribing the favourite Villiers, and by offering to open a mine of gold which he believed to exist near the Orinoco. The enterprise proved disastrous. Raleigh's force had attacked the Spaniards, and on his return James, to favour the Spanish court, with his usual meanness and pusillanimity determined to execute him on his former sentence. After a trial before a commission of the Privy Council the doom of death was pronounced against him, and was carried into execution on 29th Oct., 1618. As a politician and public character Raleigh is doubtless open to adverse criticism; but in extent of capacity and vigour of mind he had few equals, ever in an age of great men. His writings are on a variety of topics, besides a few poetical pieces of great merit. His *History of the World* is one

of the best specimens of the English of his day, being at once the style of the statesman and the scholar.—BIBLIOGRAPHY: E. W. Gosse, *Raleigh*; Martin Hume, *Sir Walter Raleigh*; Beatrice Marshall, *Sir Walter Raleigh*; Sir Sidney Lee, *Great Englishmen of the 16th Century*; T. N. Brushfield, *Bibliography of Sir Walter Raleigh*.

Raleigh, a city of North Carolina, United States, the state capital and the county seat of Wake county; served by the Raleigh & Southport, Seaboard Air Line, and the Norfolk Southern Railways. Raleigh is an educational centre, and has, among other establishments, an agricultural and mechanical college, and the medical faculty of the State university. It is also the see of a Protestant Episcopal bishop. Manufactures include phosphatic manures, cottons, hardware, and machinery. There are two railway repair-shops. Raleigh was founded in 1792 as the state capital, and was named after Sir Walter Raleigh. Pop. (1920), 27,100.

Rama (rā'ma), in Hindu mythology, the name common to a personage appearing as three incarnations of Vishnu, all of surpassing beauty.

Ramadan', **Rhamazan'**, or **Ramadhan'**, the ninth month in the Mahommedan year, during which it is said Mahomet received his first revelation. It is devoted to fasting and abstinence. From sunrise to sunset for the thirty days of its duration the Mahommedans partake of no kind of nourishment. After sunset necessary wants may be satisfied, and this permission is liberally taken advantage of. Believers are exempted in peculiar circumstances from observing the fast. As the Mahommedans reckon by lunar time, the month begins each year eleven days earlier than in the preceding year, so that in thirty-three years it occurs successively in all the seasons.

Rāmā'yana, the older of the two great Sanskrit epics, ascribed to the poet Valmiki, and dating probably from the fifth century B.C. The hero is Rama, an incarnation of Vishnu as the son of the King of Oudh. It relates his marriage with Sita, their wanderings in the forest, the seizure of Sita by the giants of Ceylon, her recovery, and the restoration of Rama to the throne of his ancestors. It contains 24,000 verses, and is divided into seven books.—Cf. A. A. Macdonell, *History of Sanskrit Literature*. There is a condensed edition of the *Rāmā'yana* and *Mahabharata*, by Romesh C. Dutt, in Everyman's Library.

Ramboot'an, the fruit of the tree *Nephelium lappaceum*, nat. ord. Sapindaceæ, much prized in the Malayan Archipelago. It is about the size of a pigeon's egg, and of a red colour.

Rambouillet (rān-bō-yā), a town of France, department of Seine-et-Oise. It is notable only for its château, long the residence of the Kings of France, and now the summer seat of the President of the Republic. Pop. 6000.

Ramée, Louise de la ('Ouida'), English novelist of French extraction, born at Bury St. Edmunds in 1840, died in 1908. She published her first novel, *Held in Bondage*, in 1863, and from then onwards was a very prolific writer. Among her best works are: *Strathmore*, *Chandos*, *Under Two Flags*, *Two Little Wooden Shoes*, *Moths*, *Wanda*, *The Tower of Taddeo*, and *The Mas-sarenes*.

Ram'esés, or **Ramses** (in Egyptian, 'the Child of the Sun'), the name given to twelve Egyptian kings of the dynasties nineteen and twenty.—**Rameses I** was the first king of the nineteenth dynasty, and was not among the most remarkable of the series.—**Rameses II**, grandson of the preceding, was the third king of the nineteenth dynasty, and his reign may be dated with fair accuracy from 1340 to 1273 B.C. He is identified by many with the Sesostris of Greek writers. His first achievement was the reduction of Ethiopia to subjection. He defeated a confederation, among whom the Khita or Hittites were the chief, in a great battle near the Orontes in Syria, and in a subsequent stage of the war took Jerusalem and other places. He was a zealous builder and a patron of art and science. He is supposed to have been the king who oppressed the Hebrews, and the father of the king under whom the exodus took place.—**Rameses III**, the Rhampsinitus of Herodotus, belonged to the twentieth dynasty, and was uniformly successful in war. He endeavoured to surpass his ancestors in the magnificence of his buildings. The mummy of Rameses II was found in 1881, that of Rameses III in 1886. The last king of the name of Rameses is supposed to have completed his reign about 1000 years before the Christian era.—Cf. J. H. Breasted, *A History of the Ancient Egyptians*.

Rameses, one of the treasure-cities of Egypt built by the Hebrews during the oppression, and probably named after Rameses II. It has been identified by Lepsius with Tell-el-Maskhûta on the Freshwater Canal (about 12 miles west of the Suez Canal), and by Brugsch with Tanis the modern San.

Ramie, or **Ramee'**, a name applied to various fibre-plants of the nettle family or to the fibre yielded by them. The chief of these are: *Bæhmeria nivea*, or China grass (also called *Urtica nivea*), and *Bæhmeria tenacissima* (or *U. tenacissima*), which some maintain to be the true ramie plant. (See *Bæhmeria*.) A kind of ramie has also been prepared from a common Euro-

pean nettle (*Urtica dioica*), and from *Laportea canadensis*, a North American nettle, introduced into Germany as a fibre-plant.



Ramie Plant (*Bœhmeria nivea*)

Ramillies (rà-mi-yē), a village of Belgium, province of Brabant, where, on 23rd May, 1706, the Duke of Marlborough gained a great victory over the French under Marshal Villeroi.

Ram Mohan Ray, an Indian rajah, founder of the Brahma-Samaj sect of theists, born at Burdwan, Bengal, 1776, died near Bristol 1833. Born of a high-caste Brahman family, he received a good education, and acquired a mastery of Sanskrit, Persian, Arabic, English, Latin, Greek, and Hebrew. He became convinced that the original Hindu religion was theistic, and he became anxious to reform the creed of his countrymen. From the perusal of the New Testament he found the doctrines of Christ more in harmony with his own opinions than any others which had come to his knowledge, and in 1820 he accordingly published a work entitled the *Precepts of Jesus the Guide to Peace and Happiness*, consisting chiefly of a selection of moral precepts from the Evangelists. In his doctrinal views he was a Unitarian, or Arian, holding, however, the pre-existence and super-angelic dignity of Christ. In 1833 he visited England as ambassador from the King of Delhi, and while there was seized with a fever, which proved fatal.

Ram'pion (*Campanula Rapunculus*), a plant of the nat. ord. Campanulaceæ, or bellworts, indigenous to Britain, as well as to various parts of the continent of Europe. Its root may be eaten in a raw state like radish, and is

by some esteemed for its pleasant nutty flavour. Both leaves and root may also be cut into winter salads. Round-headed rampion (*Phyteuma orbiculäre*) and spiked rampion (*P. spicatum*) are also British plants, the roots and young shoots of which are occasionally used as an article of food.

Rampur', a native state of Rohilkhand, India, tributary to the United Provinces. There is an adequate river system, and the state is flat and the soil alluvial. Rice from the north, and wheat, rice, maize, and sugar-cane from the southern regions, are the principal products. Cotton cloth is manufactured; sugar, rice, and hides are exported. The Oudh and Rohilkhand Railway traverses the state. Capital, Rampur City. Area, 890 sq. miles; pop. about 540,000.

Rampur Boalia, a town of Eastern Bengal, India, head-quarters of Rájsháhi district (q.v.). Pop. 24,000.

Rampur City, the capital of Rampur state, India, on the Kosi; served from Calcutta (850 miles) by the Oudh & Rohilkhand (Mordabad-Bareilly) line. It is the state metropolis, and produces pottery, damask, sword-blades, and cutlery. Pop. 72,100.

Ramsay, Allan, Scottish poet, born 1686, at Leadhills, in Lanarkshire, died at Edinburgh 1758. He removed to Edinburgh in his fifteenth year and was apprenticed to a wig-maker, an occupation which he followed till his thirtieth year. His poems, most of them printed as broadsides, soon made him widely known among all classes, and he now abandoned wig-making and commenced business as a bookseller. He was the first to start a circulating library in Scotland. In 1720 he published a collection of his poems in one volume quarto. In 1724 the first volume of *The Tea-Table Miscellany*, a *Collection of Songs*, appeared. The rapid sale of this compilation induced Ramsay to publish another, entitled *The Evergreen*, being a *Collection of Scots Poems wrote by the Ingenious before 1600*, which was equally successful. His next publication, *The Gentle Shepherd* (1725), established his fame upon a sure and lasting basis. In 1728 a second quarto volume of his poems appeared; and in 1730 his *Thirty Fables*, which concluded his public poetical labours. He did not give up his shop until within three years of his decease. He rendered great service to the vernacular literature by editing and imitating the old Scottish poetry, but his fame rests chiefly on the inimitable *Gentle Shepherd*.—Cf. Oliphant Smeaton, *Life of Allan Ramsay*.

Ramsay, Sir Andrew Crombie, Scottish geologist, born in Glasgow 1814, died in 1891. He joined the Geological Survey in 1841; was appointed to the chair of geology at University College, London, 1847; was lecturer at

the School of Mines, 1851; director-general of the Geological Survey and of the Museum of Practical Geology from 1872 to 1881. He is author of *Physical Geology and Geography of Britain and Geology of Arran*.

Ramsay, Edward Bannerman, Scottish divine and author, son of Alexander Burnett, advocate, born at Aberdeen 1793, died at Edinburgh 1872. He adopted the name of his grand-uncle Sir Alexander Ramsay, by whom he was educated. Educated at Cambridge, he took holy orders, and came to Edinburgh in 1823 as a clergyman of the Scottish Episcopal Church, becoming dean of the diocese in 1846. He is best known by his *Reminiscences of Scottish Life and Character*, which has had a great popularity.

Ramsay, Sir William, British chemist, born 1852, died 1916. His early teaching work was done in his native city of Glasgow. He became professor of chemistry at Bristol in 1880, and at University College, London, in 1887. In 1894 he and Lord Rayleigh discovered argon (q.v.). Neon (q.v.), krypton, and xenon were discovered in 1898. He was awarded the Nobel prize in 1904, and was president of the British Association in 1911.

Ramsbottom, an urban district of Lancashire, England, on the Irwell; served by the Lancashire & Yorkshire Railway. Iron- and brass-founding, calico-printing and bleaching, and many other industries are carried on. Pop. (1921), 15,370.

Ramsden, Jesse, mathematical instrument-maker, born at Halifax 1735, died at Brighton 1800. He married a daughter of Dollond, the optician, and gained great celebrity for his divided circles, transit instruments, &c. He was a Fellow of the Royal Society and of the Academy of St. Petersburg, and his instruments were known all over Europe.

Ramsgate, a seaport, watering-place, and municipal borough of England, county of Kent, in the Isle of Thanet; served by the South-Eastern & Chatham Railway, and by steamers to and from London and French ports. It possesses a fine stretch of sand and a promenade pier, and is much frequented by visitors. The harbour, which serves as a harbour of refuge for the Downs, is nearly circular, comprises an area of about 50 acres, and includes a dry dock and a patent slip for the repair of vessels. It is protected by two stone piers 2000 and 1500 feet long, with an entrance of 240 feet. Ship-building and rope-making are carried on; there is some trade in coal and timber, and a considerable fishery. Ramsgate was formerly a member of the Cinque Ports, and attached to Sandwich. During the European War it was bombarded both from the sea and from the air by German forces. Pop. (1921), 36,560.

Ramsons (*Allium ursinum*), a species of garlic found wild in many parts of Britain, and formerly cultivated in gardens.

Ramtil-oil, a bland oil similar to sesamum-oil, expressed from the seeds of a composite annual herb, *Guizotia oleifera*, cultivated in Abyssinia and various parts of India.

Ramus, Peter, or Pierre de la Ramée, French logician and classical scholar, born in Vermandois 1515, killed in the massacre of St. Bartholomew 1572. He went to Paris about 1523, and studied under great difficulties. His attacks on Aristotle and the scholastics excited violent opposition. In 1551 he was appointed royal professor of rhetoric and philosophy at Paris. In 1561 he became a Protestant. He published a *Treatise on Logic* in 1543, which obtained great success, as did also his other works on grammar, mathematics, philosophy, and theology. His doctrines were widely diffused. France, England, and particularly Scotland were full of Ramists. His logic was introduced into the University of Glasgow by Andrew Melville.

Rancé (ràñ-sā), Armand Jean le Bouthillier de, the founder of the reformed order of La Trappe, born at Paris 1626, died 1700. He embraced the ecclesiastical profession, and held no fewer than six benefices. Residing at Paris, he gave himself up to a life of dissipation. In 1657, however, a marked change took place in his character. Retiring to the abbey of La Trappe in 1664, he began those reforms which have rendered his name famous (see *La Trappe*). He passed thirty-three years in this retirement, during which he wrote a number of works, mostly of an ascetic character.

Ranchi, a district and town of India, in the Chota Nagpur division of Bihar and Orissa. The district is the largest in Bengal, and produces rice. The town is the head-quarters both of the division and of the district, and is the summer capital of Bihar and Orissa. It is also the chief missionary centre of Bengal, and the head-quarters of the Anglican diocese of Chota Nagpur. Area (district), 7000 sq. miles; pop. 1,380,000; pop. (town), 33,000.

Randers, a town of Jutland, Denmark, on the Guden-aa, about 6 miles above its mouth in the Randers Fiord. It has manufactures of gloves, margarine, railway carriages, &c. Pop. 24,000.

Randolph, Thomas, English poet and dramatist, was born in 1605, and died in 1635. His father was steward to Lord Zouch. He was a precocious child, and at the age of ten wrote *The History of the Incarnation of our Saviour* in verse. His mature work was not so edifying. He was educated at Westminster, and Trinity College, Cambridge, where he graduated B.A. in

1628, and M.A. in 1632, in which year he also became a major Fellow of his college. While still an undergraduate, he became acquainted with Ben Jonson, who adopted him as one of his 'sons'. "They both of them loved sack, and harmless mirth", as the preface to one of Randolph's plays informs us. In 1630 Randolph produced his first publication, *Aristippus, or the Joviall Philosopher, To which is added The Conceited Pedler*. *Aristippus*, which is written in prose interspersed with verse, utilizes Aristotelian logic in defence of sack as compared with small beer. It was written to be privately performed at the university. *The Conceited Pedler* is a highly amusing monologue. *The Jealous Lovers*, a comedy in blank verse, was performed before the king and queen at Cambridge in 1632. It is more ambitious, but also more self-conscious than the rest of Randolph's work, and cannot be reckoned a success. *The Muses' Looking-Glasse*, Randolph's masterpiece, was probably acted in 1632, though not printed until 1638. It is a very clever and original play, a curious blend of Aristotle and Aristophanes, which endeavours to prove that virtue is a mean between two extremes of vice. Jonson's influence is plainly to be seen. *Amyntas, or the Impossible Dowry* is a well-finished but artificial pastoral play. *Iley for Honesty, down with Knavery*, a free adaptation of Aristophanes's *Plutus*, is probably not by Randolph. Randolph was a true 'son' of Jonson's, though he rivalled his master more as a consumer of sack than as a dramatist, and thereby shortened his days. Unlike Jonson, he is learned without being pedantic, and has a larger share of the spirit of Aristophanes than is given to most English writers.

Range, an area of ground set apart and equipped for practice with fire-arms. A range may be an artillery-range, a rifle-range, a miniature range, or a 30-yards range. Of these the rifle-range is the most generally met with, and is to be found wherever troops are stationed, or in the immediate neighbourhood of military stations.

Early rifle-ranges were of a very elementary type, and consisted merely of a mound of earth or 'stop-butt' to catch the bullets; on each flank of this stop-butt were two earthen shelters for the markers, and between these two shelters or mantlets were placed two square iron targets. The strike of a bullet on the target was seen by the marker in his mantlet, and signalled to the firing-point by means of a long-handled disk of suitable colour. At intervals firing was stopped to enable the markers to clean or 'wash out' the bullet-marks on the target. With the introduction of high-velocity rifles firing a hard-envelope bullet (q.v.), iron targets were found to be unsatisfactory, owing to the danger of

splintering, and targets of canvas on a wooden frame replaced them. For convenience of marking these were often fixed on trolleys running on rails, so that after a shot they could be pulled in to the shelter of the mantlet and patched up. Then came the invention of what is known as the gallery-range, which is the type universally used now. The construction of a gallery-range entails a considerable amount of excavation at the place selected for the targets and stop-butt. The latter may be a scarped hill-side or similar natural feature if available, or it may be entirely artificial. At the position selected a deep and broad excavation is made, having the side nearest to the firing-point perpendicular, while the opposite side merges gradually into the stop-butt. The perpendicular side is riveted or bricked up to a height of 7 or 8 feet, and, if necessary, made bullet-proof above the natural ground-level by a glacis or slope of earth. A roof of timber or iron, covered with earth, is then put on, and a perfectly bullet-proof shelter in which men can work with safety is thus available. Targets in these gallery-ranges are exposed *above* the gallery or shelter instead of to one side, as was formerly the case with the old-pattern range; and, to enable this to be done, a framework is provided on the open side of the gallery. This framework is constructed on the counterweight principle, so that when one target is up and exposed to the firer, the other is down below ground-level and can be attended to by the men on duty in the gallery. The number of targets which can be used at one and the same time in a gallery-range is to all intents only limited by the length of the gallery. The target-frames are of angle-iron, knife-edge towards the firer, while the actual targets themselves are canvas on a light wooden frame. A telephone is provided on every modern range, by means of which orders and instructions can be sent from the firing-point to the butts. When it is necessary to cease firing temporarily for any purpose, the red danger-flag must be shown; while firing is in progress a red flag is always kept flying on the top of the stop-butt as a warning to those approaching the area; and, for the same reason of safety to the public, a danger-zone of at least 2500 yards should be kept behind the butts. It is unnecessary for the military authorities actually to own this area, but they must obtain firing-rights over it.

Miniature ranges are, as the name implies, ranges constructed for practice with miniature rifles (.22 bore). These ranges may either be indoors or outdoors, and all necessary precautions have to be taken for safety. When constructed indoors, any suitable building, room, or corridor may be utilized, or a special gallery may be built. The length of such a range should

never be less than 15 yards, and 25 yards is the normal length for a specially constructed indoor range, while out of doors they may extend to 100 yards. By a suitable method of lighting, indoor miniature ranges can conveniently be used at night. They are very useful for the early practice of recruits.

Thirty-yards ranges are an outdoor arrangement, and are useful for individual instruction in target-shooting with the service rifle and ammunition. They are particularly convenient in cases in which the ordinary range is at a distance from the barracks, and have the great advantage over miniature ranges that the young soldier is enabled to accustom himself to the recoil of the rifle before proceeding to use it on the open range. A 30-yards range can conveniently be constructed in an old quarry or against a vertical cliff, or a strong wall can be provided as a stop-butt. For full information regarding the construction of ranges, see *Musketry Regulations, Part II*.

An *artillery-range* is an area of country providing various tactical features and over which firing-rights can be obtained. Such a range necessarily requires a very considerable area, which can only be found satisfactorily where large stretches of moorland exist, e.g. Okehampton, in Dartmoor; while Lydd, in Kent, is also used for artillery practice. Observing-parties and markers are accommodated well away on the flanks of the targets, either behind suitable earthworks or in the open behind some natural features of the ground.

Range-finders. As the name implies, range-finders or telemeters are instruments for the determination of the distances of objects from an observation station. When the objects are invisible, the range and position, say of a gun in action, may be determined from the times the sound of the gun-discharge takes to reach three or more stations. *Sound range-finding apparatus* of this kind was highly developed during the European War. When the targets are visible, optical range-finders, from which results of great accuracy are obtainable, are usually employed.

The range determination depends upon the solution of a triangle comprising a base of known length and two sides represented by the lines of sight between the ends of the base and the target or the observing-station, according as the base is situated at the observer or

at the target. If the base length is known, the length of the side, that is, the range, can be deduced from a measurement of the parallax, that is, the difference between the base angles, since the angular field of view is comparatively small. The base of the triangle may be situated at the target, and the accuracy will then depend upon the accuracy with which the length of the base is known. *Depression range-finders*, *sextant range-finders*, and some types of *range-keepers* are instruments of this kind. When the base of known length is situated at the observing-station, to know the dimensions of any part of the target is unnecessary.

Apart from personal errors, and those attri-

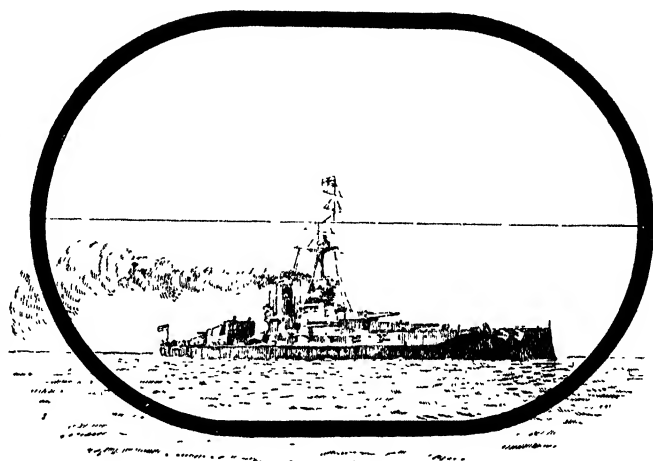


Fig. 1

butable to weather conditions, the accuracy of observation is directly proportional to the base length and to the optical magnification employed. On land it is possible to use very long base lengths, at the ends of which are situated observing-telescopes that are directed continually upon the target. Installations of this kind are known as *two-observer position-finders*. *Monostatic* or *single-observer* or *self-contained base range-finders*, which have many advantages, comprise, as these names imply, a comparatively short base, which can be directed as a whole upon the target. The images formed by light from the ends of the base are viewed by a single observer in one telescope field of view, and either the *coincidence* or the *stereoscopic* system of observation can be adopted.

In the coincidence system the images formed by rays entering the two ends of the base appear separated in the field of view by a very fine horizontal line, as indicated in fig. 1. When the images are brought into coincidence by the

suitable deviation of the rays, the range is indicated upon the scale.

In the stereoscopic arrangement the range-finder has two eyepieces, and the observer sees the various objects in perspective at apparently their respective distances, which in small instruments can be compared with a fixed perspective scale in the field of view. In larger instruments the image is moved relatively to a mark in the field at an apparent fixed distance. They are of the *wandering-mark* type, although the mark is usually fixed.

For anti-aircraft purposes, *height-finders* (one typical example of which is illustrated in fig. 2) are employed. These instruments measure not only the range, but also the height and frequently

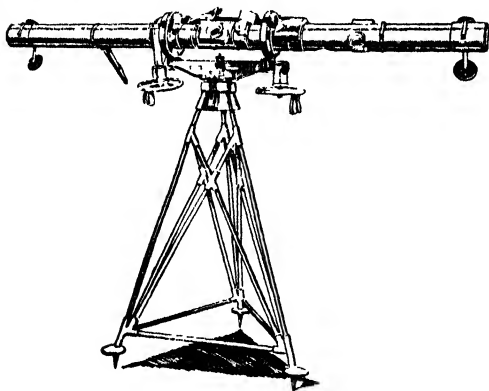


Fig. 2

the angle of sight. As the height remains very nearly constant, whereas the range changes rapidly, there is provided an automatic device that maintains the images in coincidence so long as the height is constant, and provided the object is maintained constantly in the field of view.

Rangoon', the capital and chief seaport of Burmah, is situated at the junction of the Pegu, Hlaing or Rangoon, and Pazundaung Rivers, about 21 miles from the sea. Since its occupancy by the British in 1852 Rangoon has undergone such changes that it is practically a new town, and its population has increased five-fold. There are Government buildings, town hall, law-courts, custom-house, Anglican and Roman Catholic cathedrals, St. John's College, high school, famous pagoda, &c. A large and increasing commerce is carried on with British, Indian, and Chinese ports; and an extensive trade is conducted by railway and river with the interior. The chief exports are rice, timber, cotton, hides, gums and resins, mineral oil, ivory, precious stones; the imports being mainly manufactured goods. There are rice-mills and a Government dockyard. Rangoon has been the centre of

Burmese administration since the second Burmese War, but it was never a royal capital, and its development is of comparatively recent date. Pop. (1921), 340,000.

Rangpur', a district and town of India, in the Rājshāhi division of Bengal. The district is a vast alluvial plain, traversed by the Brahmaputra, on the eastern boundary, for a distance of 80 miles, and watered by its extensive network of tributaries. The northern branch of the Eastern Bengal State Railway and many other smaller lines serve the district. Rice is the staple produce, but large areas are laid down to tobacco, which is exported to Burmah for Burmese home consumption. The town is the district head-quarters. State area, 3480 sq. miles; pop. 2,385,000; pop. (town), 16,500.

Ranke (rān'kē), Leopold von, German historian, born in 1795, died 1886. He studied at Halle and Berlin, became a teacher in the gymnasium of Frankfurt-on-the-Oder in 1818, and professor of history at the University of Berlin in 1825. His first published work (1824) was a *History of the Romance and Teutonic Nations from 1494 to 1535*. This was followed by *Princes and Peoples of Southern Europe in the 16th and 17th Centuries* (1827); *The Serbian Revolution* (1829); *History of the Popes* (1834-7); *History of Germany in the time of the Reformation* (1839-47); *History of Prussia during the 17th and 18th Centuries* (1847-8); *History of France, chiefly in the 16th and 17th Centuries* (1852-5); *History of England in the 17th Century* (1859-68); besides a number of smaller works supplementary to his *History of Germany*. At the age of eighty he undertook with undiminished vigour to write a *World History*, and a volume of this great work appeared every year until his death. His writings are chiefly valuable for the new material which he discovered in State papers, and the truth with which he presented history unbiased by personal predilections. Many of his works have been translated into English. Unlike Treitschke, Ranke, who lived before the days of intense nationalism, was cosmopolitan rather than German in his interests.—Cf. A. Guillaud, *L'Allemagne et ses historiens: Niebuhr, Ranke, Mommsen, Sybel, Treitschke*.

Rankine, William John MacQuorn, civil engineer, born at Edinburgh in 1820, died 1872. He received his instruction in natural philosophy from Professor Forbes, his practical training as an engineer from Sir J. Macneill, and he became himself professor of engineering at Glasgow University in 1855. His numerous contributions to the technical journals have been reprinted (London, 1881), and he was the author of textbooks on *Civil Engineering*, *The Steam Engine*, *Applied Mechanics*, and *Shipbuilding*. He was especially successful in

investigating mathematically the principles of mechanical and civil engineering. Rankine was also well known as a song-writer.

Rannoch, Loch, a lake, Perthshire, Scotland, 35 miles N.N.W. of Perth, 11 miles long, and about 1 mile average breadth. It contains two islands, and has an outlet for its waters in the Tummel, a tributary of the Tay. Westward from the loch extends the Moor of Rannoch, which is 28 miles long by 16 miles broad.

Ranpur, a native state of Bihar and Orissa, India, tributary to Orissa. It is one of the most ancient of the Orissa feudatories, the chiefship being traceable for 3600 years. State area, 203 sq. miles; pop. 47,000.

Ransom (Fr. *rançon*, Lat. *redemptio*), the money or price paid for the redemption of a prisoner, captive, or slave, or for goods captured by an enemy. During the Middle Ages ransoms were paid for knights and kings who were taken prisoners in battle. Thus England paid a ransom for Richard I. In the nineteenth century the exchange of officers according to rank was introduced, but occasional cases of ransom are still known. Raisuli, the Moroccan chief who captured Kaid Maclean in 1907, demanded and received from the British Government the sum of £20,000 and a consignment of military stores for his captive's release.

Ranters, a name given by way of reproach to a denomination of Christians which sprang up in 1645. They called themselves *Seekers*, the members maintaining that they were seeking for the true Church and its ordinances, and the Scriptures, which were lost.

Ranuncula'ceæ, a natural order of polypetalous dicotyledons, in almost all cases herbaceous, inhabiting the colder parts of the world, and unknown in hot countries except at considerable elevations. They have radical or alternate leaves (opposite in Clematis), regular or irregular, often large and handsome flowers, and fruits consisting of one-seeded achenes or many-seeded follicles. There are about 30 genera and 1000 species. Most have poisonous qualities, e.g. aconite and hellebore. Some are objects of beauty, as the larkspurs, ranunculus, anemone, and pæony. See next article.

Ranun'culus, a genus of herbaceous plants, the type of the nat. ord. Ranunculaceæ. They have entire, lobed, or compound leaves, and usually paniced, white or yellow flowers. The species are numerous, and almost exclusively inhabit the northern hemisphere. Almost all the species are acrid and caustic, and poisonous when taken internally, and, when externally applied, will raise blisters. The British species are known as crowfoot, buttercup, and spearwort. The common British buttercups are *R.*

acris, *R. repens*, and *R. bulbosus*; *R. Ficaria* is the lesser celandine or pilewort; *R. fluitans* and *R. aquatilis* are among the aquatic species; *R. flammula* is the lesser spearwort, common in wet meadows. *R. asiaticus* is a cultivated species, and double forms of *R. acris* and *R. aconitifolius* are known as bachelors' buttons.

Ranz-des-vaches (rânz-dā-vāsh), the name of certain simple melodies of the Swiss mountaineers, commonly played on a long trumpet called the *alpenhorn*. They consist of a few simple intervals, and have a beautiful effect in the echoes of the mountains. Rossini has introduced *ranz-des-vaches* into his opera *William Tell* with striking effect.

Rapallo, a seaport and health-resort of Italy, in the province of Genoa, at the head of the Gulf of Rapallo; served by railway from Genoa (16 miles). Near by there is a church of pilgrimage. Tunny-fishing and lace- and oil-making are among the industries.

Rapallo, Treaty of, a treaty signed by Italy and the triune kingdom of Yugo-Slavia on 12th Nov., 1920, and ratified by both nations in 1921, dealing with the status of the City of Fiume and the delimitation of the Italo-Yugo-Slav frontier. It consists of thirteen clauses, by which Fiume is given the status of an independent state with territorial contiguity to Italy. Sushak, the Croat suburb of Fiume, was attached to Yugo-Slavia, but retained the right to join its port if it so desired. In Dalmatia, Zara, with a hinterland circumscribed by a boundary of 6 miles' radius, was apportioned to Italy, together with Volosca and Abbazzia, in the Gulf of Fiume, and also the Fiume-San Pietro Railway, in order to maintain Italian territorial contiguity with Fiume. Yugo-Slavia received part of the Longatico Basin and part of the Castua region, and maintained her claim to all the Adriatic islands, excepting Lussin, Lagosta, and Cherso, which were annexed to Italy. By a further agreement Italy guaranteed provision for the educational needs of 500,000 Yugo-Slavs embraced within her new frontiers as contained within the treaty. See *Fiume*.

Rape, the carnal knowledge of a woman forcibly and against her will. By the English law this crime is felony, and is punishable with a maximum penalty of penal servitude for life. By 24 and 25 Vict. (1861) cap. c. unlawfully and carnally knowing any girl under the age of ten years, with or without her consent, was regarded as rape, and punishable as such; if the girl were between the ages of ten and twelve, the punishment was penal servitude for five years, or imprisonment not exceeding two years with or without hard labour. But by the Criminal Law Amendment Act of 1885 the maximum penalty of penal servitude for life has been extended to the

defilement of girls under thirteen; and the maximum penalty of two years' imprisonment with hard labour has been extended to the defilement of girls under sixteen years. In the case of older females consent must be withheld or there is no rape. In the United States the crime is treated as a felony, and the punishment is imprisonment for life or a term of years.—Cf. W. O. Russell, *A Treatise on Crimes and Misdemeanours*.

Rape, a division of the county of Sussex, an intermediate division between a hundred and a shire, and containing three or four hundreds. The like parts in other counties are called tithings, lathes, or wapentakes. The rapes are mentioned in *Domesday Book*.

Rape (*Brassica Napus*), a plant of the cabbage family, cultivated in Europe and India for its seeds, from which oil is extracted by grinding and pressure. It is also cultivated in England for the succulent food which its thick and fleshy stems and leaves supply to sheep when other fodder is scarce. The oil obtained from the seed, which is much the same as colza-oil, is used for various economical purposes, for burning in lamps, for lubricating machinery, in medicine, &c. The oil-cake is used as food for sheep and cattle, and as a fertilizer. Rape-cake contains about 9 per cent of oil.

Raph'ael (or **Raffaello**) **Sanzio** or **Santi**, Italian painter, was born at Urbino 1483, died at Rome 1520. His father, Giovanni Santi, a painter of some merit, who was his first teacher, died in 1494, and he was then entrusted to the care of an uncle. Here he came under the influence of Timoteo Viti, a pupil of Francia, until at the age of sixteen he was received into the studio of Perugino at Perugia. Here also he came into touch with Pinturicchio, a fellow-pupil; but he took no share, as was once thought, in that painter's decoration of the Cathedral Library at Siena. His work at this period is hardly distinguishable from that of Perugino, who is the dominant influence in his first important work, *The Marriage of the Virgin* (1504). In 1504 he visited his native town, and thence proceeded to Florence; and in this centre of the most vigorous artistic life of the time he saw and studied the work of Masaccio, Leonardo da Vinci, Michelangelo, and Fra Bartolommeo, and under their influence added to an Umbrian feeling for space and simplicity of contour a Florentine grasp of form, dramatic power, and sense of design. In Florence he began the long series of Madonnas, which includes some of his most famous works, among them the *Madonna del Gran Duca*; the *Madonna of S. Antonio*; the *Ansdei Madonna* (National Gallery), which shows an architectural quality in construction hitherto unapproached in his work; and the

Madonna del Cardellino. The most ambitious work of these years, however, was an *Entombment* (Borghese Gallery), which, despite weaknesses in design, shows how far Raphael had passed beyond Perugino in power to express form and movement. In 1508 Pope Julius II invited Raphael to assist in the decoration of the Vatican. Here, on the walls of the *Stanza della Segnatura*, next to the great hall of Constantine, he executed *The Disputa*, or *Dispute of the Fathers of the Church*, and *The School of Athens*, both of which show the transition to his third manner, in which form, space, and movement are more fully expressed than before, and fused into extraordinarily well-balanced and harmonious designs. In the same room he painted the allegorical figures of *Theology*, *Philosophy*, *Justice*, and *Poetry* in the corners of the ceiling; and on the remaining walls the *Emperor Justinian delivering the Roman Law to Tribonian*, *Gregory X giving the Decretals to an Advocate*, and *Apollo and the Muses*, surrounded by the poets of classic Greece and Rome. In the *Stanza d'Eliodoro* Raphael painted *The Expulsion of Heliodorus from the Temple* and *The Mass of Bolsena*; and after the succession of the new Pope, Leo X, *Leo the Great stopping the Progress of Attila*, *The Deliverance of Peter from Prison*; and, on the ceiling, *Moses viewing the Burning Bush*, *The Building of the Ark*, *The Sacrifice of Isaac*, and *Jacob's Dream*. With *The Conflagration of the Borgo* (*Incendio del Borgo*) extinguished by the *Prayers of Leo*, Raphael began the third stanza of the Vatican; and this was followed by *The Coronation of Charlemagne*, *Leo III's Vindication of Himself before Charlemagne*, and *The Victory of Leo IV over the Saracens at Ostia*. In all these works, however, signs of an inferior hand can be seen. During this time Raphael carried out decorations for several palaces in Rome and elsewhere, notable among which were the series in the Villa Farnesina, commissioned by the banker Agostino Chigi, to illustrate the story of Cupid and Psyche; finished the *Madonna* for the church of St. Sixtus in Piacenza (now in Dresden); painted many portraits, including those of Julius II, Leo X, Beatrice of Ferrara, the Fornarina, and of Count Castiglione; and painted some of his best-known easel pieces, such as the *Madonna della Seggiola* and the *St. Cecilia*. It was probably at a later period that Raphael prepared for Leo X the celebrated cartoons for the tapestry of one of the chambers of the Vatican, seven of which are now in the Victoria and Albert Museum, South Kensington. Raphael's last and unfinished painting—*The Transfiguration of Christ*—is in the Vatican. Attacked by a violent fever, which was increased by improper treatment, he died at the age of thirty-seven years,

and was buried with great pomp in the Pantheon. His tomb is indicated by his bust, executed by Naldini, and placed there by Carlo Maratti.—

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Ra'phia, a genus of palms, rather low trees with immense leaves, inhabiting swampy coasts. *R. vinifera*, a native of Western Africa, Madagascar, Polynesia, &c., besides yielding palm-wine, supplies materials for the roofs and other parts of houses, for basket and other work, &c. The *R. tadigera*, or Jupati palm of South America, and the *R. Ruffia* of Madagascar are equally useful. The fibre of these palms is known in Europe as *raphia* or *raffa*, and is used for matting, for tying up plants, &c.

Raph'ides, a term applied to the tiny needle-shaped crystals of calcium oxalate, aggregated in faggot-like bundles, which are often found in plant cells. They are supposed to protect the plant against the attacks of snails and browsing animals; the unpleasant burning sensation produced in the tongue and palate, if a small piece of the leaf of wild arum (*Arum maculatum*) be chewed, is evidence of their efficacy at any rate in one instance.

Rappahan'nock, a river of the United States, in Virginia, which rises in the Blue Ridge, and flows into Chesapeake Bay after a course of 250 miles. It is navigable to Fredericksburg, about 100 miles from the sea.

Rap'poltsweiler (-vi-lér), a town of Alsace-Lorraine, at the foot of the Vosges Mountains. Pop. 6000.

Rapto'res, an old-fashioned name for the birds of prey, including forms which live on other birds and animals, and are characterized by a strong, curved, sharp-edged, and sharp-pointed beak, and robust short legs, with three toes before and one behind, armed with long, strong, and crooked talons. They comprise (1) diurnal birds of prey—eagles, falcons, hawks, &c.—making up the ord. Falconiformes, and (2) nocturnal birds of prey—owls—constituting the sub-ord. Striges of the woodpecker order (Coraaciiformes). See *Ornithology*.

Raraton'ga, or Rarotonga, the largest of the Cook (Hervey) Islands, South Pacific. It is 20 miles in circuit, and has a population of (1921) 3503, 160 being white. There is a wireless station.

Rash is an eruption of the skin, found in various infectious diseases, in some skin affections, and in septic poisoning. Rashes are also produced by the action of certain drugs—drug

rash; and by food-stuffs—urticaria or nettle-rash; and by the irritation of certain plants and animals.

Rashi, properly *Rabbi Salomon-ben-Isaak*, a great Jewish rabbi, born at Troyes, France, in 1040, died 1105. His first instructor in Talmudic literature was his father, who was chief rabbi at Worms. To perfect his knowledge he made extensive journeys through Italy, Greece, Palestine, Egypt, Persia, and Germany, where he made a point of visiting the towns which possessed learned Jewish schools. His most famous work is a *Commentary on the Pentateuch*; he also wrote commentaries on the *Prophets*, the *Talmud*, and various treatises on miscellaneous subjects.

Raskolniks (Russ. *Raskolniki*, from *raskol*, schism), the collective name given to the adherents of dissenting sects in Russia, which originated by secession from the quondam State Church. The great majority of these sects date originally from the middle of the seventeenth century, when the liturgical books were revised under the patriarch Nikon. The Raskolniks clung fanatically to the old and corrupted texts, and, regarding the Tsar and the patriarch as the representatives of Antichrist, called themselves *Staro-obryadtsy* (old ritualists) or *Staroverisy* (followers of the old faith).

Raso'res, or **Scratchers**, a group of birds, formerly recognized as including tinamous, pigeons, and the modern ord. Galliformes, or game-birds, which comprises fowls, pheasants, grouse, partridges, turkeys, &c. These are characterized by the toes terminating in strong claws, for scratching up seeds, &c., and by the upper mandible being vaulted, with the nostrils pierced in a membranous space at its base, and covered by a cartilaginous scale. They are polygamous, and the young can run about and feed immediately after being hatched. See *Ornithology*.

Raspberry, the fruit of the well-known shrubby plant *Rubus Idæus*, nat. ord. Rosaceæ, and the plant itself, which is of the same genus as the bramble or blackberry, dewberry, and cloudberry. It is a native of Britain and most of Europe as well as Asia. Species are also found in America. Several varieties are cultivated, either red, flesh-coloured, or yellow. Raspberries are much used in cookery and confectionery, and the juice, mixed with a certain portion of sugar and brandy, constitutes the liquor called *raspberry brandy*. *Raspberry vinegar*, a refreshing summer beverage and cooling drink for invalids, is composed of raspberry juice, vinegar, and sugar.

Raspe, Rudolf Eric, author of *Baron Münchhausen's Narrative*, and adventurer, was born in Hanover in 1737, and died at Muckross in 1794. He studied at Göttingen and Leipzig, and be-

came professor at Cassel, and keeper of the landgrave of Hesse's collection of gems and medals. He provided an illustration of Juvenal's "*Quis custodiet ipsos custodes*", and stole some of the antique coins from the landgrave's collection. He was arrested, but managed to escape to England, and spent the remaining nineteen years of his life in the British Isles. He professed to be a mining expert, and spent several years in Cornwall. In 1791 he pretended to have discovered vast mineral wealth in Caithness, and swindled Sir John Sinclair of Ulbster out of large sums of money. The incident was made use of by Sir Walter Scott in *The Antiquary*. Raspe continued his career in Ireland until he died of scarlet fever. The original edition of *Baron Münchhausen's Narrative of his Marvellous Travels and Campaigns in Russia* appeared in 1785; it contained only chapters ii to vi of the current version, the other fifteen chapters being added by booksellers' hacks, and a sequel being added in 1793 as a parody of James Bruce's *Travels to discover the Source of the Nile*. Gottfried August Bürger (q.v.) translated the *Narrative* into German, and was for long considered to be the author.

Rasse (*Viverricula malaccensis*), a carnivorous mammal, closely allied to the civet, spread over a great extent of Asia, including Java, various parts of India, Singapore, Nepál, and other localities. Its perfume, which is secreted in a double pouch like that of the civet, is much valued by the Javanese. For its sake the animal is often kept in captivity. It is savage and irritable, and can inflict a very severe bite.

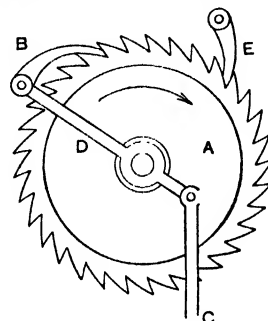
Rastadt, or **Rastatt**, a town of Baden, on the River Murg, a fortress till 1892. It contains the old castle of the Margraves of Baden. Lace and tobacco are manufactured. The Peace of Rastadt between France and the Emperor was concluded there in 1714. Pop. (1920), 12,200.

Rat, one of the rodent mammals, forming a typical example of the family Muridæ or mice. The best-known species are the (so-called) Norway or brown rat (*Mus decumānus*), and the true English or black rat (*Mus rattus*). The brown rat grows to about 9 inches in length, has a shorter tail than the other, small ears, is of a brownish colour above and white below, and is altogether a much larger and stronger animal. Supposed to have belonged originally to India and China, it only became known in Europe about the middle of the eighteenth century; but it is now found in almost every part of the habitable globe, and where it has found a footing the black rat has disappeared. It is a voracious omnivorous animal, swims readily in water, breeds four or five times in the year, each brood numbering about a dozen, and these again breed in about six months.

The black rat is usually about 7 inches in length, has a sharper head than the other, larger ears, and a much longer tail. It is much less numerous than the brown rat and more timid. To this *Mus rattus* variety belongs the white rat, which is sometimes kept as a household pet. Various other animals are called rats. See *Kangaroo-rat*; *Mole-rat*; *Musk-rat*; *Vole*.

Rat'any (*Krameria triandra*), a shrubby plant found in Peru and Bolivia, having an excessively astringent root. It is sometimes used as an astringent medicine in checking bloody or mucous discharges, weakness of the digestive organs, and even in putrid fevers. It has silver-grey foliage and pretty red starlike flowers. Written also *Rhatany*.

Ratchet and Pawl, a mechanism used to convert a reciprocating motion into a rotary one, or to allow circular motion in one direction only. The device consists of a wheel with teeth, which are in shape like those of a saw, and a small arm or finger-piece, the pawl, which engages with the wheel teeth. The device is commonly seen in braces used for drilling holes in steel plates, in the feed mechanism of many machine-tools, and in clockwork. Examples of its use in allowing motion in a single direction are also common, such as in the drive of a winch, where the drum is prevented from running back by its means.



Ratchet and Pawl

An intermittent circular motion in the direction of the arrow is transmitted to the wheel A by means of the oscillating rod D and the pawl B from the reciprocating rectilinear motion of the rod C. E is the pawl that prevents backward motion of the wheel.



Cape Ratel (*Mellivora capensis*)

Ratel', or **Honey-badger**, a carnivorous mammal of the genus *Mellivora*, and of the weasel family, found chiefly in South and West

Africa, and in India. The Cape or South African ratel (*M. capensis*) averages about 3 feet in length, including the tail, which measures 8 or 9 inches in length. The fur is thick and coarse, the colour is black on the under parts, on the muzzle, and limbs, whilst the tail, upper surface, sides, and neck are of greyish hue. It is celebrated for the destruction it makes among the nests of the wild bee, to the honey of which it is very partial.

Rates, a term applied to the taxation imposed by county, parish, municipal, and other local authorities as distinct from that imposed by the State and known as taxes. Rates are levied on the annual value of real (heritable) property—either the gross annual value, or rent without deduction, or (as generally) after deducting therefrom the probable annual average cost of the repairs, insurance, and other expenses necessary to maintain the property in the condition needful to return that value. This amount on which the rates are imposed is termed the 'rateable value' of the subjects. Usually valuations for rating are revised quinquennially. The purposes for which rates are imposed are now many and varied, e.g. relief of the poor, upkeep of roads and bridges, sanitation, police, education, libraries, lunatic asylums, registration of voters, &c. One local authority may merely state its requirements, and the rate may be levied for it by another authority. Thus the parish authorities in Scotland levy the education rate. In Scotland the rates are apportioned between owner and occupier, but in England they are assessed wholly on and paid by the occupier (except in the case of small houses, where they are paid by the owner and recovered by him from the occupier along with his rent). While, however, in Scotland rates are partly assessed on the owner, in the long run it is the tenant who pays, as the owner (except in so far as prevented by recent restrictive legislation) passes his burden on to the tenant in the shape of rent.

Premises exclusively used for public religious worship are exempt from poor and other rates, and buildings used only as Sunday schools or ragged schools may also be granted exemption. Frequently such exempted subjects are used for entertainments for admission to which there is a charge, but such use may render the subjects liable to rates.

When, as is frequently the case, a rate is made payable by instalments, each instalment is enforceable only as and when it falls due.

Rathenow, or **Rathenau** (ră'te-nou), a town of Prussia, in the province of Brandenburg, on the Havel. It has a church of the fourteenth and sixteenth centuries, and manufactures of opti-

cal instruments, wooden wares, and machinery. Pop. 25,000.

Rathlin, or **Raghery**, an island of Ireland, belonging to the county of Antrim, 5 miles north of Ballycastle. It was the site of a monastery founded by St. Columba in the sixth century, and there are the remains of a castle, in which Robert Bruce took refuge when exiled from Scotland in 1306. It is about 6½ miles long by 1½ miles broad. Pop. about 300.

Ratibor, a town of Silesia, Germany, on the Oder. Machinery and other iron goods, sugar, paper, glass, and tobacco are made. Ratibor was the capital of one of the small states of Germany in the Dark Ages, but passed to Prussia in 1745, and was formed into a duchy for the landgrave of Hesse-Rothenburg in 1821. Pop. 38,000.

Rationalism, in philosophy, is the theory which conceives reason either as the sole or as the principal source of human knowledge. Reason is to be distinguished from sense-perception, and is superior to it. Fundamental principles and conceptions are derived not from experience but from the mind by which these principles are discerned, according to some philosophers, or in which they are *innate* or *a priori*, according to others. Rationalism in philosophy has been developed by Descartes, Spinoza, Leibnitz, and Wolff. It is thus opposed to *empiricism* (q.v.). Kant, on the other hand, endeavoured to combine rationalism with empiricism, and maintained that the necessary concepts, although existing independent of experience, are valid only when used in reference to experience.

Rationalism, in theology, is the doctrine which affirms the prerogative and right of reason to decide on all matters of faith and morals whatever so-called 'authority' may have to say on the matter. Rationalism has had perhaps its chief centre and widest success in Germany; but its source may fitly be found in the English deism of the seventeenth and eighteenth centuries. In its extreme form and results, as deism and naturalism, its first English examples were Lord Herbert of Cherbury, Hobbes, and Blount (*Oracles of Reason*); while in its milder and less developed form, as a theological method adopted and applied by men still claiming the Christian name, it appeared implicitly, if not expressly and formally, in many of the later writings of the Latitudinarian party of the Church of England. This latitudinarianism, both in doctrine and ecclesiastical views, was a reaction which sprang up in the second half of the seventeenth century against that exclusive appeal to authority of scripture or church, or both combined, which had been in the ascendant during the preceding hundred years. Its

characteristic principle was the assertion of the prerogative and right of reason to decide on all questions of religion and morals—not to the exclusion of the principle of authority, but side by side with authority, reason having a legitimate jurisdiction of its own, for which it claimed due recognition and regard. But what was to be thought, more precisely, of the place and extent of this jurisdiction of reason? Was it to be regarded as subordinate to that of the authority of the Holy Scripture (to say nothing of Church authority), or as co-ordinate, or as superior and even supreme? If subordinate, to what extent or within what limits? If co-ordinate, how were the two equal jurisdictions to be reconciled and harmonized, and how were the needful concessions on either side, or both, to be managed? If superior or supreme, how were the claims of faith to be conserved side by side with those of reason, and how was the authority of the word of God as the law of Christian life to be maintained in conflict with the word of man, with the philosophy of books and of schools?

It was inevitable that the discussion of such vital and far-reaching questions should give rise to two parties among the Latitudinarians themselves—a conservative party and a progressive party—and that both these parties should exhibit all degrees of moderation and extremeness. It was no less inevitable that in such a prepared condition of men's minds on the debatable grand question of the relations of faith and reason, of man's philosophy and God's revelation, the new philosophies which had arisen in the seventeenth century—those of Bacon and Descartes—and which were to follow in the eighteenth century—those of Locke, and Leibnitz, and Kant—should exercise immense influence, and work enormous changes in the direction both of theological rationalism and of anti-Christian disbelief.

The first step taken by the English deists was to attempt to eliminate from the doctrines of Christianity whatever is above the comprehension of human reason; their next step was to discard from Christianity whatever in the way of fact was such as could not be verified by any man's experience, and this led to an attempt to get rid of Christianity altogether. German rationalism was influenced by the writings of Voltaire, the Encyclopédistes, and the sceptical freedom of thought which obtained among the French savants at the court (1740–86) of Frederick the Great. It may be said to have begun with the translation into German of Tindal's *Christianity as old as the Creation* (1741), the application of a rationalistic method by Professor Wolff of Halle University to the philosophy of Leibnitz (1736–50), and the advent

of Frederick the Great. The initial movements of rationalism were followed up by such scholars and theologians as Eberhard, Eichhorn, Paulus, Teller, and Steinbart. With the beginning of the nineteenth century, however, a new development occurred when Schleiermacher published, in 1799, his *Discourses on Religion*. In his teaching he sought to establish a distinction between the dry rationalism of the understanding and the spiritual rationalism of what he called the religious consciousness. Instead of accepting the Old and New Testaments as the supreme standard of religious truth, Schleiermacher recognized them as only the recorded consciousness of the early Church; instead of finding in revelation a divine mode of conveying doctrine, he found it to be that illumination which the human mind received from historical personages who have a genius for religion. In this form of reconstructive rationalism he was followed by De Wette, Fries, and Jacobi, and this second period continued until 1835. In this year Strauss published his *Leben Jesu* (Life of Jesus), a work in which, from the Hegelian standpoint, and in a destructive spirit, he discusses the origin of the New Testament. The movement which this originated has taken a tendency which is chiefly associated with scientific materialism, and agnosticism and rationalism as a distinctive phase of religious controversy may be said to have then ceased.—BIBLIOGRAPHY: A. W. Benn, *History of English Rationalism in the Nineteenth Century*; J. B. Bury, *A History of Freedom of Thought*; W. E. H. Lecky, *History of the Rise and Influence of Rationalism in Europe*; H. Wodehouse, article in *Hastings's Encyclopedia of Religion and Ethics*.

Ra'tisbon (Ger. *Regensburg*), a city and river-port of Bavaria, capital of the province of Oberpfalz or Upper Palatinate, stands on the Danube, opposite the junction of the Regen, 1010 feet above the sea. Among buildings are the cathedral of St. Peter, founded in 1275, completed in 1534, restored in 1830–8; the Rathaus (fourteenth century), where the German Diet held its sittings from 1663 to 1806; the Romanesque church of St. Emmeram (eleventh century); St. Ulrich's Church (thirteenth century); the palace of the Princes of Thurn und Taxis (formerly abbey of St. Emmeram). The suburb Stadtamhof, on the opposite bank of the Danube, is connected with Ratisbon by an old stone bridge. The northern gate of the Roman town was discovered in 1885. The manufactures embrace tobacco, lead and coloured pencils, porcelain and stoneware, machinery, beer, spirits, soap, and candles. The river trade is important.

Ratisbon existed under the Celtic name of *Radasbona* in pre-Roman times, and was a

Roman frontier fortress under the name of *Castra Regina*. Subsequently it became the residence of the old Dukes of Bavaria, rose to the rank of an imperial city, and was long the seat of the imperial Diet. It has stood no fewer than seventeen sieges. Pop. (1920), 52,500.

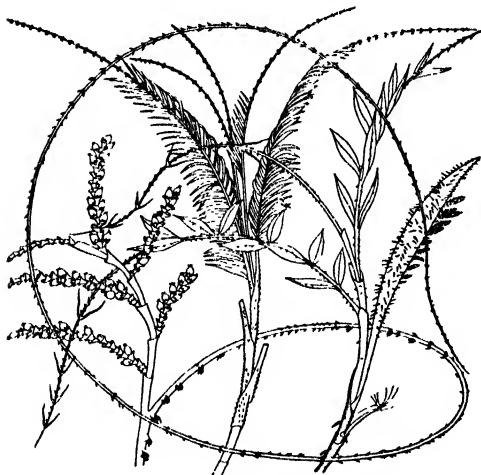
Ratitæ, the running birds, including the ostrich, emeu, cassowary, and kiwi; also the moa and other extinct forms.

Ratlam', a native state, in the Malwa division of Central India, drained by the Mahi River, and served by the Ratlam-Godhra branch of the Bombay, Baroda, & Central India Railway, and by the Rájputána-Malwa line. Wheat, maize, cotton, and the poppy (for opium) are raised. Ratlam is the capital. State area, 900 sq. miles; pop. 75,000; pop. (town), 28,000.

Ratna'giri, a maritime district and town of India, in the southern division of Bombay Province. The town has a thriving sardine-fishery carried on in January and February of each year. District area, 3990 sq. miles; pop. 1,200,000; pop. (town), 16,000.

Rat-snake, an Indian snake destitute of poison-fangs (*Zamenis mucosus*), domesticated in Ceylon on account of its usefulness in killing rats. It can easily be tamed, but is of vicious disposition.

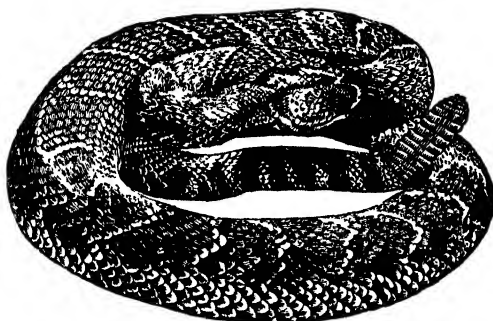
Rattans', the commercial name for the long trailing stems of various species of palm of the genus *Calamus*, such as *C. Rotang*, *C. rudentum*,



Shoot-apices of three Species of Rattans

C. Scipionum, forming a considerable article of export from India and the Eastern Archipelago. They are employed for wicker-work, seats of chairs, walking-sticks, thongs, ropes, cables, &c.

Rattlesnake, a name of various venomous American snakes of the genus *Crotalus*, family Crotalidæ, distinguished from the other members of the family by the tail terminating in a series of articulated horny pieces, which the animal vibrates in such a manner as to make a rattling sound, of 'warning' nature, which



Texas Rattlesnake (*Crotalus atrox*)

its enemies learn to associate with dangerous properties. The rattlesnake is one of the most deadly of poisonous serpents, but hogs and peccaries kill and eat it, finding protection in the thickness of their hides and the depth of their layers of fat. A number of species belong to the United States and Mexico. East of the Mississippi the *C. horridus*, or banded rattlesnake, is the best known and most dreaded species. It is naturally a sluggish animal, ready to defend itself, but seldom commencing the attack. It feeds on rats, squirrels, small rabbits, &c., and reaches a length of 5 or 6 feet. Other species are the *C. durissus*, or striped rattlesnake, found from Mexico to Brazil; *C. confluentus*, the prairie rattlesnake; and *C. terrificus*, ranging from Arizona to the Argentine, the only species found in South America.

Raven, a large bird of the crow family and genus *Corvus* (*C. corax*). Its plumage is entirely black; it is above 2 feet in length from the tip of the bill to the extremity of the tail, and about 52 inches from tip to tip of the extended wings. It can be taught to imitate human speech, and in a domestic state is remarkable for its destructiveness, thievishness, and love of glittering things. It flies high, and scents carrion, which is its favourite food, at the distance of several miles; it feeds also on fruit, small animals, &c. It is widely spread in the northern parts of both hemispheres.

Ravena'la, a fine large palm-like tree of Madagascar, ord. Musacæ (plantains), with leaves 6 to 8 feet long. It is called *travellers' tree*, because of the refreshing water found in the cup-like sheaths of the leaf-stalks. Its

leaves are used for thatch and the leaf-stalks for other purposes. The seeds are edible, and the blue pulpy fibre surrounding them yields an essential oil.



Raval Pindi

Raven'na, a maritime province of Emilia, North Italy, on the Adriatic. It is well-watered, and marshy in the north. Cereals, rice, hemp, oil, and wine are produced. Area, 715 sq. miles; pop. (estimated), 257,000.

Ravenna, a city of Italy, capital of the province of Ravenna, stands in a marshy district near the Montone. The cathedral, founded in the fourth century; the ancient baptistery, an octagonal structure; the church of San Vitale, an octagonal building in the pure Byzantine style, consecrated in 547; the basilica of San Giovanni Evangelista, founded in 424, but much altered by restoration; the basilica of San Apollinare Nuovo, erected about 500 by Theodoric as an Arian cathedral; the mausoleum of the Empress Galla Placidia, daughter of Theodosius the Great, dating from the fifth century, with beautiful mosaics; the remains of the palace of Theodoric the Great; the mausoleum of Theodoric, erected by his daughter Amalasuntha; San Apollinare in Classe, the largest of the town's basilicas, consecrated in 540, restored

in 1779; the tomb of Dante, erected in 1482; the town house; and archiepiscopal palace, are among the rich architectural features of the city. The manufactures are of little importance. Its harbour was in early times large enough to contain the fleets of Augustus, but it gradually silted up. It is now connected with the Adriatic by the Canale Corsini.

Ravenna is an ancient place, and during the decline of Rome, A.D. 402, Honorius made it the seat of the Western Empire. Thereafter it fell into the hands of Odoacer, who in his turn was expelled by Theodoric, under whom it became the capital of the Ostrogoths. It was recaptured by Belisarius, who made the town and its territory an exarchate. This exarchate was terminated by Aistulf, King of the Lombards, who made Ravenna the capital of the Lombardic Kingdom in 752. Pepin, having succeeded in expelling the Lombards, made a present of Ravenna and its exarchate to the Pope, with whom it remained till 1860. Pop. about 74,700.

Ravensburg, an old town of Württemberg, on the Schussen. It has manufactures of paper, silk, flax, and cotton. Ravensburg became a free city in 1276, and passed to Württemberg in 1810. Pop. (1920), 16,780.

Rawal Pindi, a division, district, and town of India, in the Punjab. The division comprises the five districts of Rawal Pindi, Gujrat, Shahpur, Jhelum, and Attock, and has an area of 15,740 sq. miles; pop. 2,799,300.—The district is traversed by the trunk line of the North-Western Railway. Wheat, barley, and native food grains are raised. The district is very healthy for Europeans, while the natives are of exceptionally fine physique. A cold east wind prevails in January and February, the winter is severe, and the hot season lasts from June to August only. Area, 2010 sq. miles; pop. 560,000 (80 per cent Mahommedan).—The town is the headquarters of the division and of the district, and stands on the Leh River. It has an important cantonment, workshops of North-Western Railway, gasworks, and a brewery. Pop. 87,000.

Rawlinson, Sir Henry Creswicke, born in 1810, died in 1895. He entered the Bombay army in 1827; was Political Agent in Afghanistan; Consul at Bagdad in 1844; member of the Indian Council in 1858; minister to Persia, 1859-60; sat in the House of Commons in 1858 and 1865-8; president of the Royal Geographical Society, 1871-2 and 1874-5; again on Indian Council, 1868-95. He published *Outline of the History of Assyria* (1852); *Notes on the Early History of Babylonia* (1854); a translation of Herodotus with a commentary (in which he collaborated with his brother, Rev. George Rawlinson, and with Sir Gardner Wilkinson); and *Cuneiform Inscriptions of Western Asia*,

edited along with E. Norris, G. Smith, and T. G. Pinches (1861–80). His great work was the decipherment of the Behistun cuneiform inscription (1846).

Rawlinson, Henry Seymour, first baron, British soldier, was born in 1864. He was educated at Eton and Sandhurst, and served in Burmah, the Sudan, and the South African War. During the European War he commanded the Seventh Division in Flanders in 1914; in 1915 he was given command of the Fourth Army, which he led during the Somme offensive of 1916. In 1920 he became commander-in-chief of the army in India. He died in 1925.

Rawtenstall, a municipal borough of Lancashire, England; served by the Lancashire & Yorkshire Railway. There are cotton, woollen, and slipper manufactories. Pop. (1921), 28,381.

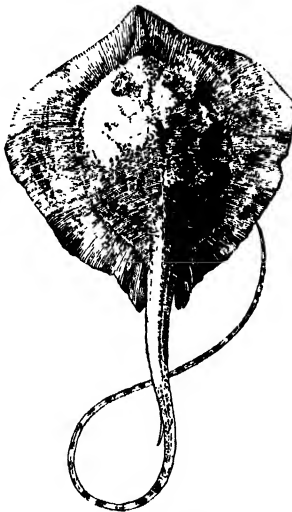
Ray, John, English naturalist, born 1627, died 1705. He was educated at Cambridge, where he subsequently lectured in Greek and mathematics. He was elected F.R.S. in 1667. Among his works are: *Historia Plantarum Generalis*, *Historia Insectorum*, and *Synopsis Methodica Avium et Piscium*. The Ray Society (founded 1844), devotes itself to the publication of botanical and zoological works, and has issued many valuable treatises.

Ray, a name of many elasmobranch fishes, including the skate and allied forms, recognized by the flattened body and by the extremely broad and fleshy pectoral fins, which seem to be mere continuations of the body. These fishes produce large eggs, which are enclosed in horny capsules quadrilateral in form, with processes at the corners, and known familiarly as 'mermaids' purses', &c. The most typical members of this group are those of the family *Raiidae*, including the thornback ray or skate (*Raia clavata*), so named from the curved spines which arm the back and tail; and the common grey or blue skate (*R. batis*), which possesses an acutely pointed muzzle, the body being somewhat lozenge-shaped, and the colour ashy-grey above. (See *Skate*.) The starry ray (*R. radiata*) is so called from having a number

of spines on its upper surface rising from rayed or starlike bases. Other families have as their respective types the sting ray (*Trygon pastinaca*; see *Sting-ray*); the electric ray (*Torpedo marmorata*; see *Torpedo*); and the eagle ray (*Myliobatis aquila*). Some of the eagle rays are known as 'devil-fishes', especially huge members of the genus *Ceratoptera*. See *Devil-fish*.

Rayleigh, John William Strutt, third Baron, physicist, born 1842, died in 1919. He was educated at Trinity College, Cambridge, where he was senior wrangler and first Smith's prizeman in 1865. In 1873 he succeeded to the title, on the death of his father. He was professor of experimental physics at Cambridge from 1879 to 1884, and of natural philosophy at the Royal Institution from 1887 to 1905, and from 1887 to 1896 he was secretary to the Royal Society. He was associated with Sir William Ramsay in the discovery of argon. Besides many scientific papers and articles, he wrote a valuable work on *The Theory of Sound* (2 vols., 1877–8; new edition, 1894–6). He received the Order of Merit in 1902, and the Nobel prize for physics in 1904.

Rays, Electric (including X-rays). It was observed by Röntgen, in 1895, that crystals of barium platino-cyanide which were lying on a bench near an exhausted tube glowed brightly when an electric discharge was passed through the tube. Photographic plates were affected, as if by exposure to light, even though protected by wrappings of opaque black paper. These effects were found to be due to radiations proceeding from those portions of the walls of the discharge-tube on which the cathode rays fell (see *Electron*). Röntgen called these radiations *X-rays*; they are sometimes also known as Röntgen rays after their discoverer. X-rays radiate out in all directions from their point of origin, travelling, like light, in straight lines. The intensity of the radiation at any point is thus inversely proportional to the square of the distance of the point from the origin of the rays. Unlike light, X-rays are neither regularly reflected nor refracted. They are, however, scattered during their passage through any material medium, so that any substance through which a beam of X-rays is passing becomes itself a source of X-radiation. This *scattered X-radiation* is always much less intense than that of the rays from which it is produced. In addition to the properties of affecting a photographic plate and causing fluorescence in certain substances, X-rays discharge a conductor when either positively or negatively charged. This is due to the formation in the surrounding air of charged gaseous ions (see *Ionization*). This power of discharging an electroscope provides the most sensitive method of detecting and the most accurate method of measuring the intensity of a beam of X-rays.



Indian Sting Ray

From a practical point of view the most important property of the rays is that of penetrating many substances which are opaque to ordinary light. No substance is perfectly transparent to the rays, and no substance is absolutely opaque. In all cases there is a gradual absorption of the rays, the amount absorbed increasing with the thickness of material traversed. For homogeneous rays the absorption is exponential; that is to say, if a plate of aluminium 1 centimetre thick cuts down the radiation to one-half, a plate 2 centimetres thick will cut down the radiation to one-quarter, and one 3 centimetres thick to one-eighth. If I_0 is the initial intensity of the beam, and I_d the intensity after passing through a thickness d of material, $I_d = I_0 e^{-\lambda d}$, where e is the base of natural logarithms, and λ is called the *coefficient of absorption* of the rays in the substance. In general, substances of low density, containing only elements of low atomic weight, are very transparent to the rays, while dense substances, especially if of high atomic weight, are very opaque. Thus paper, wood, water, and flesh are very transparent, so that the rays will readily affect a photographic plate after passing through the thickness of a man's body. A heavy metal, such as lead, is very opaque, a thickness of one-eighth of an inch being sufficient in most cases to stop the rays almost completely. Since X-rays travel in straight lines, they cast shadows in the same way as light. Thus if the hand is held between the source of rays and a fluorescent screen, the shadows of the relatively opaque bones can be seen standing out clearly against the fainter shadow cast by the nearly transparent flesh. It is this property which gives the rays their immense importance in medical diagnosis. The penetrating power of the rays increases rapidly with the potential difference used to excite the discharge-tube. With the powerful apparatus now employed it is possible to produce X-radiation which will penetrate 2 or 3 inches of steel. The examination of metal castings, &c., for flaws in the metal by means of X-rays is now becoming an important branch of metallurgy.

The suggestion that X-rays were electromagnetic pulses or waves produced by the sudden stoppage of the rapidly moving charged cathode particles was made, shortly after the discovery of the rays, by Stokes, who also suggested that the absence of regular reflection and refraction was due to the very small wave-length of the radiations. This hypothesis has been recently verified. Laue, in 1912, suggested that the cleavage planes of a crystal might be used as a sort of diffraction grating for X-rays, in which case the wave-length of the radiations could be determined by a method very similar to the determination of the wave-length of light

by a diffraction grating. The experiments were carried out by Friedrich and Knipping, and later, by an improved method, by W. H. and W. L. Bragg. The wave-lengths of the X-rays from a discharge-tube cover a considerable range of values, the average wave-length decreasing as the potential used to excite the discharge is increased. Thus the rays of small wave-length are the most penetrating. The X-rays most commonly excited have wave-lengths between 10^{-8} and 10^{-9} centimetres. Their average wave-length is thus only about one ten-thousandth of that of ordinary light. The various elements possess an X-ray spectrum which is characteristic of the element. The *characteristic radiation* of an element may be excited either by passing through it primary X-radiation of distinctly shorter wave-length than that to be excited, or by bombarding the substance in a vacuum tube with cathode rays of suitable velocity. The X-ray spectra of the elements are simpler than the optical spectra, and consist of two sets of lines, the penetrating or K series, and the absorbable or L series. The study of these lines has thrown much light on the structure of the atom (see *Matter, Spectra, Theory of; X-ray Spectra*).

X-rays produce various physiological changes in living tissues, the nature of which is not yet well understood (see *Radiology*).

The discovery of X-rays led to an exhaustive search to determine whether rays of a similar character could be produced in other ways (see *Radio-activity*). On further investigation it was found that the rays given out by radio-active substances were of three distinct kinds, which were denoted by the non-committal symbols α , β , and γ . All three types share with X-rays, though to very different degrees, the properties of penetrating substances which are opaque to ordinary light, of affecting a photographic emulsion, of lighting up a fluorescent screen, and of producing electrical conductivity in a gas. Only one type, the γ -radiation, is actually of the same nature as X-rays. The differentiation between the three types of radiation was first made by the great difference in their powers of penetration. The α -rays are completely stopped by a thickness of $\frac{1}{10}$ th millimetre of aluminium, or by 10 centimetres (4 inches) of air at atmospheric pressure. The absorption of the β -radiation is a gradual, exponential absorption, so that no very definite limit can be placed to its penetrating power. It is, however, difficult to detect its effects through a thickness of more than 1 millimetre of lead. A small residual effect can, however, be observed through as much as 4 inches of lead or 12 inches of iron. This is due to the γ -rays, which are the most penetrating type of radiation known. Absorption

provides only a crude test of the radiation. Some radio-active bodies emit a very absorbable radiation which has been shown to be of the β -ray type, although its penetration is only comparable with that of the α -rays. This is sometimes known as δ -radiation. Some kinds of γ -radiation are not much more penetrating than the most penetrating β -rays.

α -rays.—If a fluorescent screen placed near a weak source of radiation is examined with a magnifying-glass, it can be seen that the fluorescence takes the form of numerous scintillations or points of light which suddenly flash out and rapidly die away. The effect is obviously due to the impact of small particles projected from the radio-active substance. These α -particles carry a charge of positive electricity. They are, therefore, deflected by strong magnetic or electric fields, and their velocity can be determined by the method employed for cathode rays (see *Electron*). Their velocity is found to vary from about 9000 to 14,000 miles per second. The smallness of the deflections compared with those produced by similar fields in a beam of cathode rays proves that their mass is much greater than that of an electron. Rutherford has shown that they consist of atoms of helium. If a glass tube, with walls sufficiently thin to allow the α -rays to pass through them, is sealed into a discharge-tube, and is then filled with radium emanation, α -particles from the emanation collect in the discharge-tube, and after a few hours the characteristic spectrum of helium can be observed in the tube on passing the discharge. The charge on the α -particle is numerically twice that on an electron, so that an α -particle consists of a helium atom which has lost two electrons. Owing to their comparatively large mass and high velocity, the α -rays produce very intense ionization in any gas through which they pass. A single α -particle will produce as many as 86,000 pairs of ions; in fact, so violent is the impact when an α -particle strikes directly on an atom that the atom may be completely disintegrated by the blow. In this way Rutherford has succeeded in transforming nitrogen, and some other elements, into hydrogen and helium. A beam of α -rays from a given radio-active element gradually loses velocity in passing through matter, but the number of particles in the beam remains practically constant until a definite thickness of material has been traversed, when all the particles are abruptly stopped. This critical distance is known as the *range* of the particles in the substance, and depends on the initial velocity of the rays. The range of the particles is characteristic of the material from which they are ejected, and may be used to distinguish between different radio-active bodies.

β -rays.—The β -radiation consists of a stream of negative electrons (see *Electron*) travelling generally with velocities much greater than those of the cathode rays, and approaching in some instances within 1 or 2 per cent of the velocity of light. If, however, the ratio of the mass to the charge on the β -particles is investigated by measuring the magnetic and electric deflexions of the rays, it is found that the mass of a β -particle increases continuously with increase in velocity, so that the mass of the fastest β -particles is five or six times the mass of an electron in the cathode stream (see *Electron*). Owing to collisions with the atoms, a pencil of β -rays is rapidly diffused on passing through matter. After diffusion the absorption of the rays becomes exponential, the coefficient of absorption decreasing as the velocity of the rays is increased. Owing to the smaller energy of the particles, the β -rays produce less ionization and fluorescence than the α -rays. Their photographic effect is, on the contrary, much greater.

γ -rays.—The penetrating or γ -radiations are not deflected in an electric or magnetic field, and, therefore, do not consist of charged particles. The fact that γ -radiation can be produced by allowing a beam of β -rays to impinge on a lead target indicates that the relation of γ -radiation to β -radiation is the same as that of X-rays to cathode rays, that is to say, that they consist of electro-magnetic pulses. As, however, the β -rays travel, in general, much more swiftly than the cathode rays, the pulses produced are of shorter wavelength, and, therefore, more penetrating than the X-rays from an ordinary discharge-tube. This conclusion has been verified by Rutherford, using a modification of the crystal diffraction method, and the wave-lengths of the principal γ -radiations have been found to lie between 10^{-9} and 10^{-10} centimetres, or approximately one-tenth of that of ordinary X-radiation. With the ever-increasing power and voltages now being used for X-ray production, it will probably not be long before X-radiation will be produced of penetrating power equal to that of the γ -rays from radio-active substances. The origin of the γ -radiation is probably due to the sudden ejection from the radio-active atom of a β -particle, as the sudden starting of a β -particle should produce radiation of the same type as that produced when it is stopped. It may be noted that γ -rays are only emitted by radio-active substances which emit β -radiation, but there is no proportionality between the two effects. If γ -rays are allowed to impinge on a target, β -radiation is produced. A primary beam of γ -rays gives rise to secondary γ -radiation on passing through matter, and is absorbed by matter according to an exponential law. In the case of elements of

high atomic weight, characteristic γ -radiations may be excited, and these characteristic γ -rays can also be excited by β -rays of suitable velocity. These radiations have now been identified as being merely the K- and L-radiations of the elements from which they are produced.

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Razor, the well-known shaving appliance, has a blade made of the finest crucible steel. Razors of the old style were flat-sided, and were only kept in satisfactory condition by frequent grinding and honing. The hollow-ground razor was first introduced by German manufacturers, but its property of preserving for a long time a reasonable edge without honing was soon recognized, and the manufacturers in all countries installed suitable grinding plant and devoted themselves to its production. Many stones are used in turn in these grinding operations, the later stages being performed on wheels of small diameter. A successful safety razor was introduced by Gillette, in which a small flat blade with two cutting edges was held to a curved base by a cover provided with a screw connection to the handle. The guard of this razor has the form of a comb. In the new razor of this type the comb-guard has been abandoned, and the blade is held against two sharp ridges on the base, each about one-eighth of an inch from the edge. The blade, although held firmly, is quite flexible, and capable of easy adjustment to suit the different degrees of closeness of cutting. The old implement has not entirely lost favour, and where skill has been acquired in stropping gives at least as good results as any of the safety razors.

Razor-fish, the *Coryphæna novacula* of the Mediterranean, a species of fish with a compressed body, much prized for the table. See also next article.

Razor-shell, or **Razor-fish** (Solen), a genus of bivalve mollusca, forming the type of the

Solen siliqua and *S. ensis*, both of them eaten and also used for bait.

Ré (rā), Ile de, an island of France, in the Bay of Biscay, about 2 miles off the coast of the department of Charente-Inférieure, to which it belongs, 6 miles west of La Rochelle; greatest length, 18 miles; breadth, nearly 4 miles; area, 33 sq. miles. Oyster-culture, salt-making, and vine-growing are the chief industries. The chief places are St. Martin and Ars-en-Ré. A light railway traverses the island from west to east. There are four forts, and dikes for the prevention of inundations by the sea.

Reade (rēd), Charles, novelist, was born in 1814, and died in 1884. He was educated at Magdalen College, Oxford, where he took the B.A. degree, and was called to the Bar in 1843. In 1851 he began writing for the stage, and gained great success with his comedy *Masks and Faces* (1852), written in collaboration with Tom Taylor. He transformed it into a novel, *Peg Woffington*, in 1853. This was followed by *Christie Johnstone*, and *It's Never Too Late to Mend*, one of his 'novels with a purpose', in which he attacked the English prison system. The most scholarly and artistic of his writings, *The Cloister and the Hearth*, dealing with the lives of the parents of Erasmus, appeared in 1861, and among the more important of his other works are: *The Course of True Love never did run Smooth*, *Love Me Little Love Me Long*, *White Lies*, *Hard Cash*, *Griffith Gaunt*, *Foul Play*, *Put Yourself in His Place*, and *A Terrible Temptation*. He is also the author, either alone or in collaboration with others, of the following dramas: *Gold*, *Two Loves and a Life*, *The Lyons Mail*, *The King's Rival*, and *Drink* (based on Zola's *L'Assommoir*).

Reader, specifically, one whose office it is to read prayers, lessons, lectures, and the like to others; as, (a) in the Roman Catholic Church, one of the five inferior orders of the priesthood; (b) in the English Church, a layman appointed to read the lessons in churches with the consent of the incumbent; (c) a kind of lecturer or professor in universities, &c.; (d) in printing-offices, a person who reads and corrects proofs.

Reading (red'ing), a municipal borough, the county town of Berkshire, England, on the Kennet; served by the Great Western, Great Central, and London & South-Western Railways, and by the Kennet and Avon Canal.¹ Reading is a typical English county town, and a great agricultural centre.



Razor-shell

family Solenidae. The razor-shells are common on British sea-coasts; the shells are somewhat cylindrical in shape and gaping at either end. The animals possess a powerful muscular 'foot', used for burrowing swiftly into the sandy coasts which they inhabit. The familiar species are the

¹ The Kennet and Avon Canal starts from the Port of Bristol and runs via Bath (for the Somersetshire Coal Canal), Bradford-on-Avon, Semington (for the Wilts and Berks Canal), Devizes, Burbage, Hungerford, and Newbury to Reading, where it joins the Thames for Henley, Marlow Maidenhead, Windsor, Staines, and London. From Bristol to Bath is 15 miles; from Bath to Newbury, 57 miles; from Newbury to Reading, 18½ miles; and from Reading to London, 74 miles.

It has a university college, founded in 1892, which it is proposed to raise to university rank. There are also a celebrated biscuit-factory and large engineering works. Reading is an important railway junction. There are remains of a magnificent Benedictine abbey founded (1121) by Henry I, who was buried within its precincts. Pop. (1921), 92,274.

Reading, a city of Pennsylvania, United States, the county seat of Berks county, on the Schuylkill; served by the Pennsylvania Railway, by local electric-traction lines, and by the Schuylkill Canal to Philadelphia. There are shops of the Philadelphia & Reading Railway, and large iron- and steel-foundries. Reading is situated near anthracite coal-fields and iron-mines. Tobacco, hats, hardware, and hosiery are among other manufactures. Reading was laid out in 1748, and became a city in 1847. Pop. (1920), 107,784.

Rea'gent, in chemical analysis, a substance employed as a test to determine the presence of another substance. Thus, iron in solution is detected by the addition of several reagents, the most delicate being ammonium thiocyanate. This reagent gives a bright-red coloration with even minute quantities of iron in solution. Potassium ferrocyanide is also used for the detection of iron; with ferric salts it gives a deep-blue precipitate. Chemical analysis is based on the use of chemical reagents.

Real, in law, pertaining to things fixed, permanent, or immovable. Thus *real estate* is landed property, including all estates and interest in lands which are held for life or for some greater estate, and whether such lands be of freehold or copyhold-tenure. So a *real action* is an action brought for the specific recovery of lands, tenements, and hereditaments.

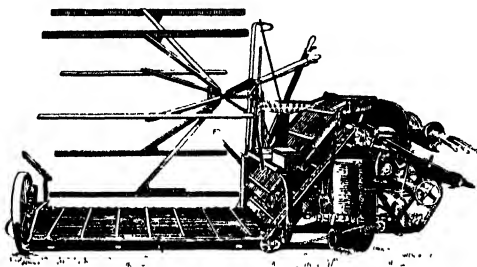
Real'gar, or **Ruby-sulphur**, As_2S_2 , one of the ores of arsenic found native in Hungary, Saxony, Switzerland, and China. It is used as an orange-red pigment.

Realism, in metaphysics, as opposed to *idealism*, the doctrine that there is an immediate or intuitive cognition of external objects, and that external objects exist independently of our sensations or conceptions. As opposed to *nominalism*, it is the doctrine that asserts that general terms like *man*, *tree*, &c., are not mere abstractions, but have real existences corresponding to them. In the Middle Ages there was a great controversy between the realists and the nominalists, the chief controversy which divided the schoolmen into rival parties. The realists maintained that things and not words are the objects of dialectics. Under the denomination of realists were comprehended the Scotists and Thomists, and all other sects of schoolmen, except the followers

of Occam and Abelard, who were nominalists. See *Idealism*; *Nominalism*.

Reaping-hook, or **Sickle**, a curved metal blade with a smooth or serrated cutting edge on the inner side of the crescent, and set in a short wooden handle, used for cutting down corn, grass, &c. It is about 18 inches in length, and tapers from a breadth of about 2 inches at the handle down to a more or less sharp point. In early times the sickle was in general use, but is now replaced by the reaping-machine.

Reaping-machine, or **Reaper**, a machine for cutting down standing corn, &c., usually worked by a pair of horses, the cutting machinery being driven by being connected with the wheels on which the machine is drawn



The Wallace Binder—rear view

The cutting blades are at the front; the binding mechanism, on the right, shows the string box, endless apron and delivery table, &c.

By permission of Messrs. Wallace (Glasgow), Ltd.

over the field. The cutting is effected rather in the manner of a pair of scissors than in that of a scythe, and a series of small toothed wheels have to be connected with the main wheel or wheels so as to produce the fast motion necessary for driving the cutting knives. These knives generally consist of triangular pieces of steel riveted to an iron bar, and are sometimes smooth-edged and sometimes tooth-edged. The knife-bar projects horizontally from the side of the machine at a short distance above the ground, and moves backwards and forwards on guides fixed at the back of a number of pointed fingers, which enter the standing grain and guide the straw to the edges of the knives. The motion of the bar being very rapid, the grain is cut down with corresponding speed, and as it is cut it is received on a platform fixed behind the knife-bar, the operator throwing it backwards by means of a rake. The sheaves are tied by hand. **Self-binder**.—A sort of revolving rake or reel, with four or five arms set in motion by the driving-wheel, brings corn well on to the knife-bar, and when cut it is delivered at the back of the machine to a binding apparatus. An endless apron receives the grain as it is cut,

and deposits it in sheaves in a suitable receptacle, where by ingenious mechanical arrangements the sheaf is caught and compressed by iron arms; twine from a reel is passed round it, fastened by knotting, cut away, and the bound sheaf is tossed out. The sheaves may also be bound with wire, straw, rope, &c. Reaping and thrashing machinery are often combined in America. Some machines cut off merely the ears from the standing corn, leaving the straw. See *Agriculture*; *Tractor*.

Reason (Lat. *ratio*), a term used in mental philosophy to denote a faculty of the mind which enables man to deduce conclusions from facts or from propositions, and especially to draw *valid* inferences from true premises. It distinguishes the true from the false, right from wrong, and enables man to choose the proper means for the attainment of particular ends. Hume restricted the function of reason, withdrawing from its domain the discernment of right and wrong, whilst Locke wrote that "reason is conversant with certainty alone, while the discovery of that which, as probable, enforces a contingent assent or opinion is ascribed to an especial faculty, called the judgment".

Man has been called a *rational animal*, and reason is the highest faculty of the human mind, distinguishing man from the animals. The latter, it must be admitted, frequently direct their actions intelligently to desired ends, but they do not possess man's power to think in general terms. It is by means of reason that man is able to contemplate things spiritual as well as material, to weigh all that can be said or thought for and against them, and hence to draw conclusions and to act accordingly. Reason is thus synonymous with *intellect* and is opposed to *instinct*. It is to be distinguished from imagination, feeling, and desire, or from the faculty which enables man to learn certain truths intuitively. The terms *reason* and *understanding* have been considered as identical by English philosophers; but Kant set up an antithesis, distinguishing between reason (*Vernunft*) and understanding (*Verstand*). The former, rising above experience, is the principle of principles; it speculatively verifies every special principle, or practically determines the proper ends of human action. The latter conceives of sensible objects within experience, which it again compares one with another, or with particular representations of them, or with the objects themselves. — **BIBLIOGRAPHY:** Thomas Whitaker, article in Hastings's *Encyclopædia of Religion and Ethics*; J. M. Baldwin, *Dictionary of Philosophy and Psychology*.

Rebellion, the taking up of arms, whether by natural subjects or others, residing in the

country, against a settled Government. By international law rebellion is considered a crime, and all persons voluntarily abetting it are criminals whether subjects or foreigners. When a rebellion has attained such dimensions and organization as to make of the rebel party a state *de facto*, and its acts reach the dimensions of war *de facto*, it is now the custom of the State to yield to the rebels such belligerent privileges as policy and humanity require, and to treat captives as prisoners of war.

Récamier (ră-ká-mi-ă), Jeanne Françoise Julie Adélaïde, whose maiden name was Bernard, born at Lyons 1777, died 1840. At the age of sixteen she went to Paris, and was there married to Jacques Récamier, a rich banker, more than double her own age. From this time her aim was to surround herself with personal admirers, and to attract to her salon the chief personages in French literature and politics. Her husband becoming bankrupt, she went to reside with Madame de Staël in Switzerland, having been banished from Paris in 1811 by Napoleon on account of her intimacy with his enemies. At the downfall of Napoleon she returned to Paris, and again opened her salon, which as before continued to be a resort of men of intellect till her death. She had very intimate relations with Benjamin Constant and Chateaubriand.—Cf. H. N. Williams, *Madame Récamier and Her Friends*.

Receipt, a written acknowledgment or account of something received, as money, goods, &c. A receipt of money may be in part or in full payment of a debt, and it operates as an acquittance or discharge of the debt only as far as it goes. In Britain if a receipt for a sum of £2 or upwards does not bear the twopenny Government stamp, it is inadmissible as evidence of payment. The stamp may be either adhesive or impressed on the paper. Formerly there were special adhesive receipt stamps, but the twopenny postage stamp now serves also for receipts.

Receiver, in England, a person appointed by the High Court to receive the rents and profits of land, or the produce of other property, which is in dispute; also a person appointed in suits concerning the estates of infants, and other cases. The *receiver-general* is an officer of the Duchy of Lancaster, who receives its revenues, &c. For *official receivers* see *Bankrupt*.

Receiver of Stolen Goods, one who takes stolen goods from a thief, knowing them to be stolen, and incurs the guilt of partaking in the crime. Receivers of stolen property are liable to penal servitude for from three to fourteen years, or imprisonment for two years with or without hard labour.

Receiving Order is an order issued by

the court in England on presentation of a bankruptcy petition either at the instance of the debtor himself or at the instance of a creditor. It vests the property of the debtor in the Official Receiver for the purposes of protection and management until a further order of the court or an arrangement among the creditors be made. Not only does such an order preclude the debtor from intruding with his estate, but it also suspends all separate legal proceedings by his creditors. It thus affords time for full investigation of the debtor's affairs and for the avoidance of bankruptcy, if possible, by a composition arrangement.

Recent Formation, in geology, the name given to the later of the two series into which the post-Tertiary formation has been divided, the former or earlier being the post-Pliocene. This 'recent' series includes all superficial accumulations, as sand, gravel, silt, marl, peat-moss, coral reefs, &c., from the close of the last ice age down to and comprising those accumulations that are still in process of being formed.

Receptacle, in botany, a name given to the more or less enlarged and modified apex of the pedicel or peduncle, upon which all the parts of a flower are directly or indirectly borne; also known as the *torus* or *thalamus*. The term is also applied to the common axis of some compressed inflorescences, such as the head, especially in the ord. Compositæ; and sometimes to the axis bearing the fructification in ferns, mosses, Algæ, and Fungi.

Rechabite, among the ancient Jews, one of a family or tribe of Kenites whom Jonadab, the son of Rechab, bound to abstain from wine, from building houses, from sowing seed, and from planting vines (cf. *Jer.* xxxv, 6, 7). In modern application the Rechabites are a benefit society composed of total abstainers from intoxicating drinks, called the Independent Order of Rechabites.

Reciprocity, in international trade, is a special arrangement between two nations by which the citizens of each obtain advantages or privileges in their trading relations with the other. Commercial treaties have been concluded between states since the earliest times. The text is extant of treaties of commerce and navigation between Carthage and Rome in 509 and 348 B.C. The term 'reciprocity' first came into use, however, in 1815, when a treaty between Great Britain and the United States was concluded in which the restrictions on shipping were reciprocally relaxed. About ten years later the same principle was applied to protective tariffs, and some writers began to advocate the policy of basing international trading relations upon reciprocal concessions, so that no nation would admit the goods of

another on more favourable terms than the other nation granted to the exports of the first. The treaty that Cobden negotiated with France in 1860 was reciprocal in its general character, but care was taken to avoid the suggestion that the lightening or removal of British duties on imports from France was conditional on the more favourable treatment of our exports to France. After Great Britain had adopted a free trade policy, the advocates of reciprocity began to urge that retaliatory duties should be levied on imports from those countries which taxed our exports. This proposal formed part of the tariff reform policy put forward by the late Joseph Chamberlain.

The 'reciprocity treaty' is a favourite instrument of the United States Government. Under such a treaty one nation grants another special reductions of import duties in return for equivalent reductions by the other country. Such concessions are, however, frequently extended to further nations *en bloc* through the instrumentality of 'the most favoured nation clause', a general promise, which is often included in commercial treaties, to concede to the state in the treaty all advantages which may be granted to any other state.

Recitative, in music, may be regarded as the link between speech and song. In it the subtle variations of pitch which occur in normal speech are replaced by the larger and definitely fixed intervals of the musical scale, while the rhythmic freedom of prose is secured by an absence of the regular time-divisions which are an essential feature of ordinary music. Recitative was first written in the closing years of the sixteenth century, and through all the intervening centuries has preserved some of the musical turns of phrase that appeared in the earliest examples, notably the descent from the key-note to the fifth of the scale, which forms the almost universal close. Recitative is used in opera and oratorio, where the text calls for a more rapid musical expression than is possible under the conditions of normal composition. In *recitativo secco* the accompaniment consists only of occasional chords placed where necessary to make the phrases harmonically clear. In *recitativo stromentato* a fuller and more musically interesting support is given by the accompanying instruments, which are also, in general, more numerous. In *mezzo recitativo* the accompaniment is musically complete in itself, but does not thereby curtail the freedom of the vocal declamation. A further development of this last style forms the foundation of Wagner's method of composition, particularly in his later operas.

Reclaiming, in Scots law, the process of appealing from a judgment of the lord-ordinary

to the inner house of the Court of Session. A *reclaiming note* is the petition of appeal to the inner house craving the alteration of the judgment reclaimed against.

Reclamation, the winning of land from the sea. There are many types of activity which may be considered under this heading, such as the protection of the coasts against erosion, the building of sea-walls to protect lands which would otherwise be covered at high tide, and the raising of the coast-line lands by the use of groynes. Great tracts of land have been reclaimed from the sea in many places on the coasts of Europe. The Romans made successful reclamations in the Fen district, and in the seventeenth and eighteenth centuries the land of Sunk Island, in the Humber, and large areas in the Dee estuary were won from the water-covered banks. At later dates similar endeavours have proved successful on the Seine, the Ribble, and the Tees. The reclamations by the use of embankments in Holland are perhaps the most extensive of all. Where embankments are made use of for this purpose, the built-up material must not only be capable of withstanding the steady pressures and considerable shocks caused by the sea, but must also be treated in such a way as to be totally impermeable to water. When the substances available at the place of working are of such a character that the building of a water-tight embankment is otherwise impossible, recourse is made to the use of a puddled-clay wall, inserted within the bank to supply the necessary character. Clay is kneaded with water, and is built up as the centre or core of the bank (see *Reservoir*). This wall must be carried down to a sound rock or clay foundation, which is commonly only obtained at some depth below the base of the embankment. The drainage of reclaimed land in Holland is effected with windmill-driven pumps. Breaches have been closed by piling and planking up in the region of the gap, by the insertion of lowering panels in specially constructed frames, and by building an additional bank or wall behind the gap. In extreme cases the sinking of old boats filled with shore material and cement has proved an effective solution.

At the estuary of a river the building of banks forming a channel through which the river is to pass is followed by the accretion of deposits of rich soil on the parts outside the channel. Foreshores at such places are soon built up, and a growth of coarse grass quickly follows.

Groynes consist of erections of timber in the form of screens built out to sea. The wind- and tide-swept material is banked up against the groynes, and the level of the shore is raised.

In places where coast erosion is taking place

the building of sea-walls of heavy stone is a necessity if the lands are to be conserved. These walls are built of a shape which changes from a gradually curved slope at the foot to an almost vertical straight rise at the higher parts, and they are sometimes provided with a top which is curved and projecting towards the sea to cast back the waves that break on the wall. Such erections are common at seaside places. At Blackpool the wall is built up of hexagonal basalt piers. When groynes are not fitted at the base of such sea-walls, the stonework must be carried to some distance below the shore to ensure that water cannot cut away the material below the wall.

Recognizance, in law, an obligation of record which a man enters into before some court of record, or magistrate duly authorized, with particular conditions: as to appear at the assizes or quarter-sessions, to keep the peace, &c.

Reconnaissance. "Detailed and timely information about the enemy and the theatre of operations is a necessary factor of success in war." These words, from the British *Field Service Regulations*, explain the bedrock principle on which information is sought in war, and the methods followed to obtain this information are known as reconnaissance; or, again, in the words of the British *Field Service Regulations*, "Reconnaissance is the service of obtaining information with regard to the topography and resources of a country and the movements and dispositions of an enemy."

'Si vis pacem, para bellum', and any Government which takes its duty seriously will prepare for war during peace by collecting information about other nations. Should war at any future time ensue, such a Government will be in possession of much general information about the enemy country and its resources; but more detailed and peculiar information will be required by the commander-in-chief and those entrusted with the conduct of the war. The acquisition of this will entail special long-distance reconnaissance, which will in these modern days be undertaken by the air force, with a view to checking the information already possessed and supplementing it with more accurate and definite information as to preliminary concentrations and probable lines of advance. This is known as strategic reconnaissance, and will be carried out not only at the commencement of a campaign, but also as circumstances require during its continuance.

In connection with the two words 'strategic' and 'tactical' it may be as well to note the old definitions which have been current for many years, and which, in a general way, are as suitable now as they were at the end of last century. Strategy is the art of moving troops in the

theatre of operations; tactics that of moving them in presence of the enemy. Owing to modern developments, strategy and tactics overlap a good deal more than they did formerly, but for the purposes of this article the definitions will serve.

'Tactical reconnaissance' will take place, therefore, at closer quarters, when the opposing troops are approaching within striking distance or are even in contact. The information sought under this heading will principally be confined to obtaining early and accurate details as to what the enemy is doing, and topographical information as to the country in the immediate neighbourhood, and to discovering how his troops are disposed. The methods of obtaining such information are varied, and range from the employment of paid intelligence agents under the control of general headquarters through aeroplanes working with the particular formation which requires the information, to special detachments of mounted or dismounted troops working within touch of their respective brigades and divisions.

When a body of troops is sent out on a reconnoitring expedition, the commander must be given detailed instructions as to what points require clearing up; and he must remember that his primary duty is to obtain that information and not to consider that he is invested with a roving commission to do as he pleases. Fighting may be necessary in order to elucidate the situation, but it should be avoided unless the required information cannot be obtained in any other way. Good examples of fighting in order to obtain information were the trench raids of the European War, which were undertaken partly to worry the enemy by a system of pinpricks, but more particularly to keep in touch with his dispositions by a knowledge of what troops were holding a given part of the line. The trench raid had generally fulfilled its object when it succeeded in bringing back a live prisoner, who could be interrogated by the intelligence branch of the general staff. In the European War, and probably to an increasing extent in the future, reconnaissance both strategical and tactical became, and will continue to be, largely a matter for the air force; but however excellent the machines, the cameras, and the wireless, however efficient and daring the pilots and the observers, there must come a time when subordinate commanders must depend for information gathered for them by the ordinary cavalry or infantry officers and soldiers working and observing on the ground.

Reconnaissance must not be confused with espionage (q.v.), for, though the object of both is to obtain information, the methods employed are totally different. The secret-service agent

or spy works, so to speak, underground, and depends for his results on secrecy and disguise, and when caught is liable to be shot out of hand. The airman or soldier or body of troops carrying out a reconnaissance, each and all of them, are performing a recognized act of war, and though, of course, any means may be used to kill or capture them, yet when once captured they become ordinary prisoners of war and must be treated as such.

Reconstruction, in commercial law, occurs when a company registered under the Companies Acts is to be wound up, and its business and assets sold or transferred to another company (which is usually formed for the purpose), the consideration for the sale or transfer being shares or other like interests in the transferee company. This is a scheme frequently resorted to when a company has fallen on evil days and it is thought that it can be saved by the issue of further capital, which the shareholders may be willing to subscribe in the hope of salving their interests. Generally, each shareholder in the transferor company receives shares in the transferee company in proportion to his holding in the former; but whereas the shares of the former company were fully paid up, those of the new company are issued only as partly paid, and each member requires to face an assessment. Thus a company with a capital of (say) £20,000 in 20,000 fully paid shares of £1 each may sell its undertaking to a new company for (say) 20,000 shares of £1 each 10s. paid, and each member will then receive for every share held by him in the transferor company one share of £1 issued as paid up to the extent of 10s. in the new company. There is thus a liability of 10s. per share on each member, and a fund is available for the business. Provision is made in the Companies Acts for the purchase by the liquidator of the interest of any member of the transferor company who dissents from the proposed reconstruction.

Reconstruction, Ministry of, a British Government department instituted in 1917 to prepare for the conclusion of the European War, and to carry out the stabilization of industry and the restoration to normal employment of the fighting forces and munition-workers when peace should actually be signed. In Aug., 1917, the ministry was formally established, with Dr. Addison as the first Minister of Reconstruction. The Ministry of National Service was afterwards merged in the new department, and the whole was known as the Ministry of National Service and Reconstruction. It ceased to exist after Sept., 1920.

Rec'ord, specifically, an official copy of any writing, or account of any facts and proceed-

ings, whether public or private, entered in a book for preservation. In a popular sense the term *records* is applied to all public documents preserved in a recognized repository. The English records date back to 1100. Scottish records are preserved in the General Register House, Edinburgh, Irish in Dublin, and the English at the Public Record Office, in London. The Act of 1838 conferred the guardianship of the English records on the Master of the Rolls, who in 1857 began the publication of the valuable series of chronicles and memorials known as the Rolls Series. In the legal sense of the term *records* are authentic testimonies in writing, of judicial acts and proceedings, contained in rolls of parchment, and preserved, the courts of which the proceedings are thus preserved being called *courts of record*. In Scots law the record consists of the written statements or pleadings of parties in a litigation, and the 'closing of the record' is a formal step, sanctioned by the judge, after each party has put forward all he wishes to say by way of statement and answer.

Recorder, the title of the justice of the peace who presides at the quarter-sessions in a borough. He must be a barrister of five years' standing. He has a limited appellate jurisdiction, and may try most crimes except murder and treason. See *Quarter-sessions*.

Recording Instruments show not only the value of the reading at the moment, but also, by means of a graph drawn upon scaled paper, how the quantity has varied from time to time. Instruments of most characters have been fitted with the gear necessary to make them of the recording type.

In electrical instruments, such as ammeters and voltmeters, the changes necessary are the provision of a pen-fitting to the end of the needle or pointer and clockwork-operated drums, which are provided with a roll of paper. The pen-fitting consists of a small cylindrical ink-vessel through which the pen proper is passed. The pen has the form of a thin metal wedge with a very small hole through it.

The barograph is a form of barometer in which the pressure changes are drawn to scale upon a chart. In this case a single drum is used, and to it the paper is fixed. The paper is divided up by lines for each hour of the day, and by a height scale which gives the value of the pressure.

Instruments have been designed by J. F. Campbell, Sir G. G. Stokes, and others to record the amount of sunshine during a day, a week, or other interval.

Thermographic charts of the conditions in a cold store provide useful information about the working of the plant and the watchfulness of the staff. Records are made of the temperatures in the cold chambers of vessels used for trans-

porting perishable food-stuffs, where the maintenance of low temperatures within prescribed limits is a condition exacted by the exporters. The values of these temperature limits are given in the article *Ice-making and Refrigeration*.

Recorders are frequently installed in boiler-houses to provide permanent records of the amount of carbon dioxide in the flue gases. One system on which such instruments work is the measurement of the difference in volume before and after the carbon dioxide has been absorbed in a solvent, such as caustic potash. Incomplete combustion means such a considerable loss of available heat that in many large steam plants the boiler attendants are awarded bonuses on the approximation of the average of the carbon dioxide contents in the flue gases during their shifts to the value theoretically possible.

Recording of Milk, a method of selecting dairy stock by keeping a systematic record of the milk yielded by each cow in the herd throughout the year. This record enables the owner to determine exactly the quality and quantity of milk yielded by any particular cow, and marks out the profitable animals which may be bred from to improve the general tone of the herd, the unprofitable beasts being eliminated altogether. Milk records have been kept by private individuals for many years, but it is only recently that the system has been developed on a large scale. In 1895 co-operative testing began in Denmark, where a society was formed, and rapidly spread through Scandinavia. On the initiation of the late John Speir, the Highland and Agricultural Society of Scotland instituted a milk-recording scheme (1903) whereby, during the first year, 34 herds containing 1342 cows were tested for a period of six months. Work continued under the society until 1907, when the Ayrshire Cattle Milk Records Association assumed control, and eventually this body became the Scottish Milk Records Association,¹ with head-quarters at Ayr. See *Testing of Milk*.

¹ The organization comprises certain groups of co-operative societies, each comprising twelve or more farmers. When such a society has been formed, a recorder is appointed by the Association. This recorder is certificated as a milk tester (Scotland) by the Dairy School, Kilmarnock, and is supplied with a Gerber testing outfit, spring balance, special sheets and books, and sometimes a pony and trap or other suitable means of transport where farmers are unable to attend to this matter themselves. Each farmer's cows are tested fortnightly, and the total amount of milk yielded during the intervening period is estimated by multiplying the quantity yielded on the day of testing by the number of days since the previous test.

Record Office. Though Henry I interested himself in the preservation of documents of national importance, the Public Record Office, now housed in a fine building erected in 1900 between Chancery Lane and Fetter Lane, may be regarded as to some extent the foundation

of Queen Elizabeth, who in 1578 established the State Paper Office. This remained independent until 1854, when, together with collections from the Tower of London and other depositories, its contents were transferred to the Record Office, of which the ex officio keeper is the Master of the Rolls. Under his guardianship have now been brought together the ancient Rolls of Parliament, the Pipe Roll or Great Roll of the Exchequer, with the records of the higher and Palatine Courts, the Duchy of Lancaster, &c. There is further a vast collection of such historical records as are not retained by various public departments; in short, to quote the Act of 1838, "all rolls, records, writs, books, proceedings, decrees, bills, warrants, accounts, papers, and documents whatsoever, of a public nature, belonging to Her Majesty". Many of these may, if prior to a certain date, be inspected by the public free of charge. From time to time there are published Calendars of the Records. The General Register House, Edinburgh, is the depository for Scottish national records, where they are classed either in the historical department, which may be consulted by those engaged in research work, or in the General Record Office, chiefly containing legal records. The public records and State papers of Ireland were, until lately, housed in the Record Tower of Dublin Castle or in the building known as the Four Courts. Many priceless documents were lost for ever when the latter establishment was besieged, blown up, and burnt in July, 1922.—Cf. S. R. Scargill-Bird, *Guide to the Public Record Office*.

Rectification, in chemistry, a term applied to purification of a volatile liquid by repeated distillation to free it from impurities either more volatile or less volatile than itself. The term is mostly applied to the purification of crude ethyl alcohol. Purified alcohol after rectification is known as *rectified spirit*.

Rector, in the English Church, a clergyman who has the charge and cure of a parish, and has the parsonage and tithes; or the parson of a parish where the tithes are not inappropriate. The heads of Exeter and Lincoln Colleges, Oxford, are also so called, and the chief elective officer of the Scottish universities receives the same title. In Scotland it is also the title of the headmaster of an academy or important public school.

Recurring Series, in algebra, a series in which the coefficient of any power of x is a linear function of a certain number of the preceding coefficients. Thus $a + (a + 1)x + (2a + 1)x^2 + (3a + 2)x^3 + (5a + 3)x^4 + \dots$ is a recurring series, each coefficient (after the second) being the sum of the two coefficients immediately preceding it.

Red. See *Colour; Paints and Pigments; Spectrum*.

Red Algæ, Rhodophyceæ, or Floridææ, one of the great groups of Algæ, distinguished by the red, pink, or purple colour of their chromatophores (which nevertheless contain chlorophyll as well as red pigment) and by their peculiar reproductive organs. Red Algæ are practically all marine and flourish best at considerable depths, their reddish coloration enabling them to take full advantage of the blue rays of light that preponderate in deep water; a number, however, are found in tidal pools on our coasts, especially species of *Polysiphonia* and *Ceramium*, *Rhodymenia palmata* (dulse), *Chondrus crispus* (carrageen), &c. The thallus displays great diversity of form and structure, but is always filamentous in type. The life-history has been worked out for one or two species only, such as *Polysiphonia violacea* (see *Polysiphonia*). Few Rhodophyceæ are of economic importance.

Red-bird, the popular name of several birds in the United States, as the cardinal (*Cardinalis virginianus*), the *Tanagra æstiva* or summer red-bird, the *Tanagra rubra*, and the Baltimore oriole (*Icterus baltimore*).

Redbreast, or Robin Redbreast (*Erithacus rubecula*), a species of perching bird belonging to the sub-family Sylviinae (warblers) of the thrush family. The red breast of the male is the distinguishing feature of these well-known birds, the female possessing a breast of a duller yellowish-brown colour. The young are of a dull yellowish-green colour, and want the characteristic breast-colouring of the adult. In Britain the redbreast is a permanent resident, but in more northern countries it appears to be migratory, flying southwards in winter. It is a permanent bird in all the temperate parts of Europe, and it also occurs in Asia Minor and in North Africa. The nest is made of moss and leaves, and is lined internally with feathers. The eggs number five or six, and are white, spotted with pale brown. The robin redbreast of America is a thrush, the *Turdus migratorius*; and one of the bluebirds, the *Sialia sialis*, is usually called the blue robin. The species of the Australian genus *Petroica*, allied to the wheatears, and remarkable for their bright plumage, are called by the colonists 'robins'.

Red Cedar, a species of juniper (*Juniperus virginiana*) found in North America and the West Indies; the heartwood is of a bright red, smooth, and moderately soft, and is in much request for the outsides of black-lead pencils.

Red Coral (*Corallium nobile*), an important genus of colonial corals belonging to the ord. Alcyonaria. Red coral is highly valued for the manufacture of jewellery, and is obtained from the coasts of Sicily, Italy, and other parts of the Mediterranean, ranging west to the Cape Verde Islands.

Red Cross Societies have adopted their now familiar title since the Convention of Geneva (1863), when the flag and badge—a red cross in a field of white—became the emblem of such important national aid societies as the Order of the Hospital of St. John of Jerusalem (English), the French Société de Secours aux Militaires Blessés, and the Samariter Verein (Austrian). The terrible sufferings of the sick and wounded during the Crimean War, and perhaps still more those occasioned by the enormous casualties of Solferino, attracted the sympathetic attention of the world, and made it clear that the army medical service could not cope effectively with the needs of modern battlefields. The International Convention of Geneva recommended the formation of committees for the provision of trained nurses and hospital stores; the neutrality and security of hospitals, their patients, and their staffs; and the adoption of a distinctive badge and flag. Every civilized nation agreed to observe these recommendations, but this did not, in the European War, prevent the Germans from ignoring them, from persistently firing on both land and sea hospitals, or from treating the enemy's wounded with revolting inhumanity. Nor did they scruple to prostitute the Red Cross flag by hoisting it above their own dug-outs and trenches as a method of escaping attack. The beneficent activities of the Red Cross societies are far from being in abeyance during peace; their attention is then turned to the general welfare of the community and the relief of the suffering—the provision of adequate comforts to the sick poor, the supply of ambulance vehicles, &c. The decoration of the Royal Red Cross (instituted 1883) is bestowed on nurses of eminently distinguished service.—**BIBLIOGRAPHY:** Pearson and MacLaughlin, *Under the Red Cross*; G. Moynier, *The Red Cross: its Past and Future* (translated by Furley, 1883); Sir John Furley, *In Peace and War*.

Red'ditch, an urban district and town of Worcestershire, England, on the Arrow; served by the Midland Railway. Needles, hooks and eyes, fishing-tackle, and automobiles are made. Pop. (1921), 16,240.

Reddle, Raddle, Ruddle, or Red Chalk, a species of argillaceous ironstone. It occurs in opaque masses, having a compact texture. It is used as a pigment of a florid red colour. Sheep are generally marked with it.

Redeemable Rights, in law, those conveyances in property or in security which contain a clause whereby the granter, or any other person therein named, may, on payment of a certain sum, redeem the lands or subjects conveyed.

Redempt'orists, a religious congregation founded in Naples by Liguori in 1732. They

devote themselves to the education of youth and the spread of Roman Catholicism. They style themselves members of the congregation of the Holy Redeemer. Expelled from Germany in 1873, they were readmitted in 1894. In 1880 they were driven out of France. They are called also *Liguorists*.

Red Gum is the popular name for a red papular eruption which occurs in infants about the time of dentition. It is usually seen in the more exposed parts, the head, arms, and legs, and it varies considerably in degree and duration. The condition is most frequently observed in undernourished and weakly infants.

Red Gum Tree, one of the Australian *Eucalypti* (*Eucalyptus resinifera*), yielding a gum-resin valued for medicinal uses.

Red Lead, or **Minium**, (Pb_3O_4), an oxide of lead obtained by direct oxidation of metallic lead. The process takes place in two stages. The first is the transformation of lead into lead monoxide, PbO , or massicot, and the second stage is the conversion of lead monoxide into red lead by further heating in presence of oxygen. The colour of the red lead depends greatly on the conditions of oxidation. Red lead is a crystalline reddish powder which when strongly heated evolves oxygen. It is much used as a pigment, as a cement for jointing pipes, for hardening oils, &c.

Redmond, John Edward, Irish politician, born in 1851, and died in London 1918. He was educated at Trinity College, Dublin; was called to the English Bar (Gray's Inn) in 1886, but never practised; and entered Parliament as member for New Ross in 1881, subsequently representing North Wexford (1885-91), and finally Waterford City (from 1892). Redmond followed Parnell to the last, and on the death of his leader in 1891 he assumed control of the party. After the general election of 1910 Redmond became a real power in Parliament, and Mr. Asquith introduced and passed a Home Rule Bill (1912-4). On the outbreak of the European War John Redmond declared for the unity of all parties, and assured the Government of Irish loyalty. He assisted recruiting, but opposed the application of conscription to Ireland. See *Ireland*; *Home Rule*.

Red Pine, a species of pine (*Pinus rubra*), also called *Norway Pine*. Its wood is very resinous and durable, and is much used in house- and shipbuilding. It produces turpentine, tar, pitch, resin, and lampblack.

Redpoll, or **Redpole**, a name given to several species of linnet-like birds, especially to the lesser redpoll (*Ægithus rufescens*). The mealy or stone redpoll (*Linota linaria*) is a winter visitor to England.

Red River, a river of the United States. the

southernmost of the great tributaries of the Mississippi. It rises in Northern Texas, and has several sources, the chief, besides the main stream, being called the North and South Forks, which unite with it on the boundary of the states of Texas and Oklahoma. The stream then flows east-south-east, forming the boundary between Texas and Oklahoma, and between Texas and Arkansas; cuts off a corner of the latter state, and then flowing through Louisiana falls into the Mississippi, 125 miles north-west of New Orleans; total course estimated at 1550 miles; chief affluent, the Washita, which joins it in Louisiana. About 1200 miles of the river are useful for navigation.

Red River of the North, a river of North America, which rises in Elbow Lake, in Minnesota, flows south and south-west, and then nearly north, crossing from the United States into Manitoba, where it falls into Lake Winnipeg. Its entire length is 665 miles, 525 of which are in the United States. It is joined by the Assiniboine. The city of Winnipeg stands at the junction of the two rivers.

Red River Settlement, a settlement formed in 1812 by the Earl of Selkirk on the banks of the above river; repurchased by the Hudson Bay Company in 1836; finally transferred to the Canadian Government in 1870, and now part of the province of Manitoba.

Red Root, a name given to several plants, one of them *Ceanothus americanus*, nat. ord. Rhamnaceæ. It has simple alternate leaves and large red roots, and is found in North America, where the leaves are used sometimes to make an infusion of tea.

Red'ruth, an urban district and town of Cornwall, England; served by the Great Western Railway. The inhabitants are principally employed in the tin- and copper-mines of the neighbourhood. Pop. (1921), 9920.

Red Sea (ancient *Mare Rubrum*, or *Mare Erythræum*), a branch of the Indian Ocean, communicating with it by the Strait of Bab-al-Mandeb, stretching in a north-north-west direction between Arabia on the east and North-East Africa on the west, and connected with the Mediterranean on the north by the Suez Canal. It occupies a depression in the floor of the Great Rift Valley, with a length of about 1200 miles, and a greatest breadth of 205 miles (in lat. 19° N.). At the northern end it bifurcates into the Gulf of Akaba, penetrating into Arabia for about 100 miles, with an average breadth of about 15 miles; and the Gulf of Suez, which penetrates between Sinai and Egypt for about 200 miles, with an average breadth of about 20 miles. The shores consist generally of a low, coral-fringed, sandy tract, varying in width from

10 to 30 miles, and suddenly terminated by the abutments of the Arabian and African massifs. There are three channels formed by coral reefs and islands, which run generally in conformity with the outline of the coast. In the central or main navigable channel the depth reaches in one place 1200 fathoms (lat. 21° N.), but diminishes towards the extremities to 40 fathoms, while in the harbour of Suez it amounts to only 3 fathoms. From October to May, when the wind sets steadily from the south, a strong current flows in from the Strait of Bab-al-Mandeb; while from May to October the north wind continues to blow, which gives the current a southerly direction. The result of this is to raise the sea-level by several feet north and south alternately.

Considered as an oceanic gulf, the Red Sea is one of the most remarkable phenomena in existence. It receives the waters of no rivers of any consequence, and what poor streams do exist are intermittent, while the evaporation from the surface is enormous. Under such conditions of supply the whole basin would rapidly be converted into a mass of solid rock-salt, and as this has not taken place, it must be inferred that an outward current flows into the Indian Ocean beneath the inward surface current. (See note to *Persia: Physiography; Palestine: Jordan Valley; Dead Sea.*) The waters are deep-blue in colour and of exceptional clarity, but are more saline than those of the ocean in the proportion of about 4 to 3·5, the relative densities being 1·030 and 1·026 at a temperature of 60° F.

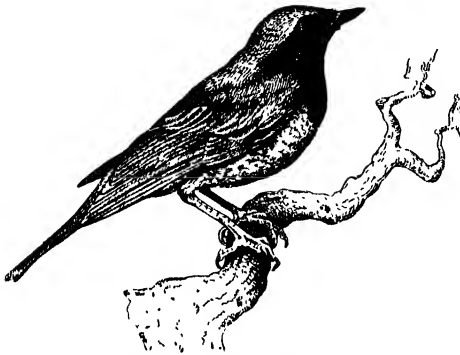
Port Sudan and Aden are the only ports visited by passenger liners, and journeys to other coastal points are made either by coasting steamer or by Arab dhow. Among other ports are: Jeddah (the port for the *hajj*—pilgrims proceeding to Mecca), Al-Wedj, and Yambo, all of which are Hejaz outlets; Hodeidah, Mocha, Massawa, and Perim Island.

In the Scriptures the Red Sea is mainly dealt with in *Exodus*, being first mentioned in connection with the plague of locusts (x, 19); see also *Joel*, ii, 20. The crossing made by the Israelites at an undetermined place, supposed to be located on the Gulf of Suez, is described (*Ex.* xiv, 15–30; see also *Ex.* xiii, 18; *Ex.* xiv, 2–9; *Num.* xxxiii, 6–12), which, from a little external evidence and much pure guesswork, is placed at the southern end of the modern Suez Canal. The Gulf of Suez was formerly called *Sinus Heroopolites*, because it extended to Heroopolis, in or near the Bitter Lakes. By the Hebrews the Red Sea has long been called *Yam Sâph*, or 'weedy sea', and, although the origin of the name is lost in antiquity, it is taken to refer to the submarine forests of coral-

line structure for which the sea is so justly famed. See *Egypt (History)*; and map under *Sudan*.

Redshank, a bird of the plover family belonging to the genus *Totanus*, the *T. calidris*, so called from its red legs. It is about 11 inches long, resides in Britain all the year, but is known also as a summer bird of passage in the most northern parts of Europe and Asia, occurring in winter as far south as India. The spotted redshank (*T. fuscus*) visits Britain in spring and autumn on its migrations north and south.

Redstart, a bird (*Ruticilla phænicura*) belonging to the thrush family (Turdidæ), nearly allied to the redbreast, but having a more



Redstart (*Ruticilla phænicura*)

slender form and a narrower bill. It is found in almost all parts of Britain as a summer bird of passage, and has a soft sweet song. The tail is red, whence the name, *start* being Old English *steort*, a tail. The forehead is white, the throat black, the upper parts lead-grey or brown. The black redstart (*Phænicura titys*) is distinguished from the common redstart by being sooty black on the breast and belly where the other is reddish brown, and is only an occasional visitor to Great Britain. The American redstart (*Setophaga ruticilla*) is a small bird of the family Mniotiltidæ, common in most parts of North America.

Red-top, a well-known species of bent-grass, the *Agrostis vulgaris*, highly valued in the United States for pasturage and hay for cattle. Called also *English Grass* and *Herd's-grass*.

Reduction, in Scots law, an action for setting aside a deed, writing, &c. The object of this class of actions is to reduce and set aside deeds, services, decrees, and rights, whether heritable or moveable, against which the pursuer of the action can allege and instruct sufficient legal grounds of reduction.

Reduction Division, in plants, that nuclear division in which the number of the chromo-

somes is reduced by one-half; it marks the end of the diploid and the beginning of the haploid portion of the nuclear cycle. In the Higher Plants it always takes place during the formation of spores from spore-mother-cells, thus terminating the sporophyte phase, but among Thallophytes its position in the life-history is more variable. See *Generations, Alternation of*.

Red-water, in cattle, a disease known by the prominent symptom of discoloured urine of varying shade, from reddish to dark-purple or black; but it has more to do with the liver than other organs, infection being conveyed by ticks and possibly other insects. *Symptoms*.—A dull and staring coat; stiffness of the hind-limbs, or arching of the loin; dry, hot mouth, muzzle, and horns; lost appetite; a poor, weak pulse; often palpitation of the heart; constipation; tenderness over the loin and belly; urine frequently passed, but in small quantities and discoloured. In many instances nothing is noticed until red urine is passed; in some cases pains, as of colic, are displayed, and delirium brings others to a fatal termination. *Treatment*.—There is much difference of opinion as to this, but the general experience in red-water districts is in favour of an early purge by equal parts of salt and Epsom salts. $\frac{1}{2}$ lb. of each or 1 lb. of table salt in 1 gallon of water is favoured by some practical farmers and cow-keepers. A favourite drench with farmers of the old school was 2 oz. of aloes, 2 oz. of nitre, 1 oz. of ginger, and 1 lb. of salts, followed next day by 1 oz. of spirit of turpentine in $\frac{1}{2}$ pint of linseed-oil, night and morning. Turpentine is another of those remedies which tend both to destroy the enemies of red blood corpuscles, and to hold the latter together to resist disintegration. Tonics should follow, such as quinine, gentian, nux vomica, and fenugreek. In the case of cows affected, the milk is reduced in quantity and quality, and they should be given cordials when recovering to stimulate the active secretion of the lacteal glands. For this purpose $\frac{1}{4}$ oz. each of fennel, fenugreek, aniseeds, gentian, cummin, caraways, and nitre may be given night and morning with the food. *Prevention*.—As the disease is more prevalent on undrained and sour land, drainage is believed to be helpful. All frosted turnips and bad fodder should be avoided. Ticks should regularly be looked for in cows when milked.

Redwing, a species of thrush (*Turdus iliacus*), well known in Britain as a winter bird of passage. It spends the summer in the northern parts of Europe and Asia, its winter range extending to the Mediterranean. It is about equal to the song thrush in size, congregates in large flocks, and has an exquisite song.

Red-wood, the name of various sorts of wood

of a red colour, as an Indian dyewood, the produce of *Pterocarpus santalinus*; the wood of *Gordonia Hematoxylon*, the red-wood of Jamaica; that of *Pterocarpus dalbergioides*, or Andaman wood; that of *Ceanothus colubrinus*, the red-wood of the Bahamas; that of *Sequoia sempervirens*, a coniferous tree of California, the red-wood of the timber trade; that of *Soyimida febrifuga*, of which the bark is used in India for fevers, and has been employed successfully in Europe for typhus. The California red-wood is the best known. The tree reaches a very great size, and forms forests in the coast mountains of California. It can stand the climate of Britain.

Reebok (rā'bok; that is, roebuck), a species of South African antelope, the *Pelea capreolus*. The horns are smooth, long, straight, and slender. The reebok is 2½ feet high at the shoulder, of a slighter and more graceful form than the generality of other antelopes, and extremely swift.

Reed, a name usually applied indiscriminately to all tall, broad-leaved grasses which grow along the banks of streams, pools, and lakes, and even to other plants with similar leaves, growing in such situation, as the bamboo. Strictly speaking, however, it is the name given to plants of the genera *Arundo*, *Psamma*, and *Phragmites*, and especially to *Phragmites communis* (the common reed). This, the largest of all the grasses of northern climates, is used for roofing cottages, &c. It is exceeded in size by the *Arundo donax* of Southern Europe, which sometimes grows to the height of 12 feet. The sea-reed or mat-grass (*Ammophila* (or *Psamma*) *arenaria*) is often an important agent in binding together the masses of loose sand on seashores. The bur-reed of Britain is of the genus *Sparganium* of the reed-mace order. See *Reed-mace*.

Reed-fish (*Calamichthys calabaricus*), a snake-shaped fish covered with rhomboidal bony plates, and devoid of pelvic fins. It is found in certain West African rivers, and belongs to the family Polypteridae, that also includes the Bichir.

Reed-mace, a plant of the genus *Typha*, nat. ord. Typhaceæ. Two species are British, *T. latifolia*, or greater reed-mace, and *T. angustifolia*, the lesser. These plants are also known by the names of *cat-tail* and *bulrush*, and grow in ditches and marshy places, and in the borders of ponds, lakes, and rivers. They are tall, stout, erect plants, sometimes 6 or 8 feet high, with creeping root-stocks, long flag-like leaves, and long dense cylindrical brown spikes of minute flowers. They are sometimes erroneously called bulrush.

Reel, a Scottish dance, in one part of which the couples usually swing or whirl round, and in the other pass and repass each other, forming the figure 8. The music for this dance, called by the same name, is generally written in common

time of four crotchets in a bar, but sometimes in jig time of six quavers.

Reeve, in old English history, an official having authority for fiscal and other purposes within a defined area. The reeve of a *borough* was called a *borough-reeve*; of a mercantile town, a *port-reeve*; and of a shire, a *shire-reeve* or sheriff. The word reeve is still used in Canada.

Reeves, John Sims, English tenor singer, born at Woolwich in 1818, died in 1900. He studied singing under Hobbs and T. Cooke; appeared as a baritone on the stage at Newcastle in 1839; joined a company at Drury Lane under Macready as second tenor in 1842; visited the Continent and studied under Bordogni at Paris, and Mazzucato at Milan; and in 1847 returned to England, where he met with great success. He devoted himself more especially to oratorio and ballad singing. He published an autobiography in 1888.

Reference, in law, the process of assigning a cause depending in court, or some particular point in a cause for a hearing and decision, to persons appointed by the court.

Referen'dum, in politics, a term applied to a device or plan by which a proposed measure—especially some highly important constitutional change—is referred directly to the whole body of those possessing the political franchise instead of to their elected representatives, or for confirmation or rejection after it has been dealt with by their representatives. The referendum has long been employed in the cantons of Switzerland, and also by the Federal Government of the Republic. Thus, in 1920, the question of Switzerland's joining the League of Nations was finally decided by a referendum or the direct vote of the electors. A referendum is provided for in the Constitution of the Commonwealth of Australia, and has been employed there, one notable instance being the referendum of 1916, when the question of conscription under the Military Service Act was decided by the voters, the result being an adverse majority. The referendum exists in the United States, and its adoption has been proposed in Great Britain. A permissive referendum is one in which laws are submitted to popular vote only when a petition, duly signed by a certain number of persons, is presented within a prescribed period after the chambers have approved of the law, as in certain cantons of Switzerland. See *Plebiscite*.

Reflection, the change of direction which a wave in ether or in a material medium experiences when it strikes a surface and is thrown back into the medium from which it approached. A transverse disturbance travelling along a stretched cord is said to be reflected when it reaches the fixed end of the cord; in this and in analogous cases a change of phase takes place at reflection. As regards direction, the waves reflected from a

plane surface are inclined to the normal, drawn to the reflecting surface, at the same angle as the incident waves. If the reflector is curved, the same law holds if we consider the effect of a small element of the surface to be the same as if it were plane. The law of reflection has been verified for radiant heat and light, and reflected waves of sound have been shown, by photography, to follow the same law. Perfect reflection of the wave does not take place in any case, as reflection is accompanied by absorption or transmission; silver reflects 90 per cent of the intensity of light waves, and water about 1·7 per cent for small angles of incidence. In certain cases the reflection is selective, and the substances are said to possess surface colour and to exhibit metallic reflection.

Reflector, a polished surface of metal, or any other suitable material, applied for the purpose of reflecting rays of light, heat, or sound in any

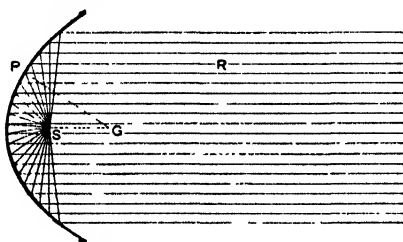


Diagram of a Parabolic Reflector

required direction. Reflectors may be either plane or curvilinear; of the former the common mirror is a familiar example. Curvilinear reflectors admit of a great variety of forms, but the parabolic form is perhaps the most generally serviceable, its usefulness depending on the following property of a parabola. Let *s* (see fig.) be the focus of the parabola; then the normal *ps* at *p* bisects the angle between *rs* and the line *pr* parallel to the axis. Hence (see *Light*) a ray from *s*, reflected from the parabola at *p*, will proceed along *pr*. The reflected rays collectively will therefore form a parallel beam, which can be directed as required, and loses comparatively little in intensity with distance.

Reflex Nervous Action is an action which is the result of an afferent or sensory nerve impulse. Thus a speck of dust falls into the eye, and there is almost instantaneously a movement of the eyelids in an attempt to get rid of it. The movement of the eyelids is a reflex action, and is not performed consciously.

Reform Acts. The various Reform Acts of the nineteenth century were the outcome of a long-continued and steadily increasing demand for a really representative form of government. The Revolution of 1688 was one against mon-

archical tyranny, and essentially aristocratic in character; the government of the country still remained for another century and half in the hands of the great territorial magnates; although, as early as 1766, Chatham was in favour of a measure of reform, while it is probable that only the absorbing business of the Napoleonic wars kept Pitt from carrying some reforms into effect. The first Reform Bill, introduced by Lord John Russell in 1830, and becoming law in 1832, had sweeping results. It abolished fifty-six family and 'rotten' boroughs; reduced the number of members returnable to Parliament by many others; gave additional members to the counties; and for the first time conferred the privilege of parliamentary representation on Manchester, Birmingham, and about forty other thriving centres of trade and population. But, though adding some 500,000 voters to the poll, it did little or nothing for the working-classes. Agitation continued, and assumed more or less violent forms. Thirty-five years later Disraeli, who was fully alive to the political advantages to be derived from an appeal to the masses, and who, with others, had already made some abortive steps to that end, introduced a measure which became law in 1867. The second Reform Bill enfranchised all rateable male householders in boroughs, and gave the vote to a large number of lodgers; also to owners of small properties and lands. More small boroughs were disfranchised; a third member was allotted to the towns of Manchester, Liverpool, Birmingham, and Leeds; and representation was conferred on the University of London. In the following year the Scottish and Irish Reform Bills were passed. In Ireland there was no redistribution; but some additional seats were created in Scotland. The English Bill gave to the boroughs what was practically household franchise, a benefit which, in 1884, Mr. Gladstone proposed to extend to the counties. The Upper House was for some time strongly opposed to the step; but as the result of a compromise the Bill was passed on 6th Dec., 1884, and 2,000,000 voters were added to the electorate. Six months later a Redistribution Bill became law. For a brief but clear account of the Reform Acts the reader is referred to Justin McCarthy's *Short History of Our Own Times*.

Reformation. The Reformation is the historical name for the upheaval of religious and social and intellectual forces which, in the sixteenth century, changed the face of Europe. The word ought to be spelt 'Re-formation', for the leaders of the movement were dominated by a positive aim. It was their fundamental conviction that the Church, which had been formed in the apostolic age, required to be re-formed after the corruptions of mediæval Romanism. This conviction was at bottom a religious prin-

ciple. The Reformation was a revival of religion upon a great scale. But it was supported and inspired by a number of other forces, which had been gathering for several centuries. There was the impulse given by the Renaissance of learning, which recovered the classics and revived the study of ancient civilization. This led to the emphasis upon the first pure form of Christianity as represented in the New Testament, an emphasis favoured by men like Erasmus, who did not follow the religious implications to their full extent. The need for a new formation of the Church was accentuated by the prevailing impatience with the state of religion in the Roman Church. The economic scandals of the day, under the Papal régime, the immorality of monasteries and nunneries, the flagrant vice of the clergy, and also the rising tide of nationalism which beat at the centralization and inefficiency of the Papal government, all contributed to the break. Demands for a general council to reform the Church had been persistently evaded. The Vanity Fair drawn by Bunyan, as Professor Gwatkin observes, "is the Rome of the Renaissance, drawn by an enemy, but drawn to the life, and in no way overdrawn". And in the realm of thought the rising claims of truth as opposed to a system built upon tradition, such as the schoolmen sought to defend, necessitated a change. Like all such changes, the Reformation did at once more and less than its original promoters imagined. It arose out of an apparently simple cause. The spark that kindled the conflagration was the opposition of Luther, a German monk, to the scandalous hawking of indulgences for sin which was going on in Germany, in order to raise money for the Pope in Italy. Luther's moral sense revolted against this abuse of religion, and he was backed by German patriotism, for the German princes as well as many of the people resented the scandal not only on religious grounds, but because it took money out of Germany. This was in 1517. The protest spread, involving much more than the mere question of selling pardons for money. It came to be realized that the entire doctrinal system of the mediæval Papacy was in need of a thorough reform, and the subsequent progress of the movement showed how this conviction was shared far beyond Germany. Once started, it was swelled by a number of other forces, selfish and mixed. The possessions of the Church were coveted by greedy barons and rulers; anti-social forces saw their chance of success in the turmoil; and national interests of a semi-political character often made a tool of the reforming spirit. But an analysis of the movement shows that the driving-power was religious.

In two directions the movement worked with mixed effects. (a) It broke up the unity of the outward organism, which was religious as well

as social. The Reformed Churches were, in the nature of the case, national rather than international, and they were divided by differences of opinion as well as by differences of race. But it must be remembered that the so-called unity of the Church was unreal. There had never been one Church since the Greek and the Roman Churches had parted. The unity had been a sectional Western unity, and a unity based upon what now seemed irreligious grounds, external rather than real. The reformers believed in unity, but it must be the unity of truth and right, first pure then peaceable. No reformer dreamed of breaking the real unity of the Church, and the true reformers held to their catholicity with fervour, defining catholicity as inner fellowship. (b) In the second place, the Reformation did not become conscious of itself equally. Few realized how much they were carrying over from mediæval catholicism, even as they broke with it. Variations appeared at once. Reformers occupied positions between the conservative and the radical schools, in theology and in Church organization, and these differences were largely due not only to temperament but to the factor of the State, which in some countries was the safeguard of the Church as reformed, in others the antagonist. Hence the differences between the Calvinist and the Lutheran Churches, for example. The latter hardly spread beyond Germany. With the exception of Scandinavia, no country adopted the Lutheran ecclesiastical and doctrinal position. Calvinism 'was the fighting wing of the Reformation', in Switzerland, in the Netherlands, and in Scotland pre-eminently. It consolidated Christians; it inspired them with a positive belief and with a firm discipline. In England it was modified, but in countries like Scotland and Switzerland it appealed to the mental as well as to the social instincts of the people; though not democratic in the modern sense, it made for the rights of the people as against any clerical domination.

In Germany the struggle ended in 1555, when the Peace of Augsburg formally recognized the Reformed Churches as legal. Strife followed, but the principle was won by a combination of political and religious forces. In Switzerland the Reformation assumed a character which was not parallel to that of the German Reformation, owing to the popular government of the country. In France the long struggle developed into bitter wars, and as in Spain, though less severely, the reformers were crushed by the authorities. In Scotland, under the inspiration of Calvinism, the people carried the reformation against the throne, and in England for semi-political reasons Romanism was doomed by the policy of Henry VIII. The identification of Spain with the Roman cause, and the disastrous effects of the Armada, sealed the fate of the Roman faith in England

under Elizabeth, who was a Protestant almost in spite of herself. The Reformation in England was not so thoroughgoing as elsewhere, partly because the national temperament was less radical, partly because the royal policy from the first was not interested in any real reformation of morals or of doctrine. Such changes were due, so far as they were ever introduced, to the popular feeling, and they never succeeded in reforming the ecclesiastical framework as in Scotland or in Germany.

To trace the effects of the Reformation is more difficult than to analyse its causes. Broadly speaking, we may say that it meant a real advance in religion as well as in civilization. The extravagances which characterized it were largely due to the repressive policy which had resisted any reform for centuries, and which only prepared to grant a few reforms when it was too late. The movement was by no means perfect; it had not thought out its own principles of individualism and liberty, nor was it invariably prepared to act upon them even when they were realized. Toleration was still in the background, and liberty of opinion was only admitted with serious restrictions. But the positive gains were immense, and the drawbacks are small compared with them. The Bible was translated, religion was brought to the people, education was promoted, and a higher standard of morality inculcated. The seeds were sown of after-development, far beyond what the reformers themselves realized, and later ages saw the harvest. Inevitably a great upheaval like the Reformation produced evils, the evils incident to a change which affects the entire life of the people. Haste and imperfect thought made some of the intellectual and ecclesiastical constructions of the period inadequate. Reaction followed, and the essential principles of the movement had to be recovered—in some cases discovered. But upon an historical survey the Reformation is justified as the separation between the Greek and the Latin Churches cannot be; it was the result of deep religious forces, and it has been the cause of a deep religious change.

BIBLIOGRAPHY: The standard work in English is T. M. Lindsay's *History of the Reformation*. Add the second volume of the *Cambridge Modern History*; Beard, *Reformation in relation to Modern Thought*; H. B. Workman, *Dawn of the Reformation*; Frederic Seebohm, *Era of the Protestant Revolution*; R. H. Murray, *Erasmus and Luther*.

Reformatory and Industrial Schools. In so far as these two classes of establishments are founded and maintained by individuals—or, more often, by county councils or municipal authorities—they are to that extent private institutions; but, before being put to their intended use, they require the sanction of the

Home Office, and are further subject to the periodical visits of its inspectors. Industrial schools do not receive actual juvenile criminals, but only children who are in danger of becoming such, owing to their being habitual truants from the elementary schools, associates of thieves or other disreputable persons, mendicants, or the children of imprisoned criminals. For such causes magistrates may commit a child, provided it is under fourteen years of age, to an industrial school. The schools are supported by grants from the Treasury and from local authorities, and in some cases also by payment from the parents or guardians of the child. The term of committal may be modified on account of good conduct, by permission to reside outside its limits, to emigrate, or be apprenticed to a trade. Reformatory schools are for actual offenders against the law. The age of the offender must be between twelve and sixteen, and the length of confinement varies from two to five years, but in no case must continue after the age of nineteen; nor must imprisonment in an ordinary jail precede committal to the school. There are, besides the ordinary institutions, both industrial and reformatory ships. Another branch of the industrial school is the 'day' establishment, where children attend daily and are fed. Reformatory schools in Britain date from 1854.

Reformed Church, in general, comprehends those Churches which were formed at the Reformation; but the term is specifically applied to those Protestant Churches which did not embrace the doctrines and discipline of Luther. The title was first assumed by the French Protestants, but afterwards became the common denomination of all the Calvinistic Churches on the European continent. In Germany Reformed Churches are called Evangelical Churches. The Reformed Church of America is a body known up to 1867 as the Reformed Protestant Dutch Church, being founded by settlers from Holland and holding Calvinistic doctrines. As the original members spoke Dutch, this language was long used in public worship.

Refraction, the change of direction which waves undergo when they pass from one medium into a second one—an effect which has been observed with waves of sound, radiant heat, light, and Hertzian waves.

That light rays were refracted when entering another medium was known at an early period, but no definite relation between the angle of incidence i (fig. 1) and the angle of refraction r was discovered until Snell (1621) showed that the ratio of the sine of the angle of incidence to the sine of the angle of refraction, or $\sin i / \sin r$, was constant. This ratio, n , is known as the index of refraction for the two media. Usually one of the media is air, and if the second medium is

glass, n is referred to as the refractive index of glass. Huygens explained the bending of the rays of light as due to the difference in the velocities of light in the two media. Let AB (fig. 2) be the front of a plane wave moving with velocity v_1 obliquely to the surface AC of the second medium. The point A becomes a source

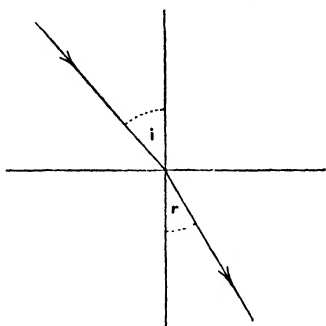


Fig. 1

of radiation into the second medium, and in time t the spherical wave from A reaches D at the instant when the disturbance at B reaches C . CD , the tangent plane to the sphere, gives the new wave front, and from the figure $BC = AC \sin i$, and $AD = AC \sin r$; hence $BC/AD = \sin i / \sin r = n$. But $BC = v_1 t$, and $AD = v_2 t$, from which it follows that $n = v_1/v_2$.

When a ray passes from air through a transparent medium with parallel surfaces, such as

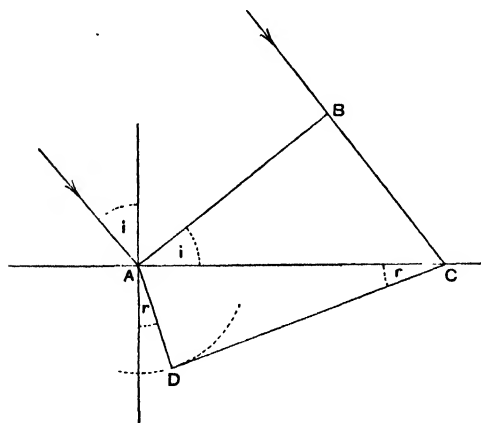


Fig. 2

a sheet of plate glass, an application of the law of refraction will bring out that the emergent ray CD (fig. 3) is parallel to the incident ray AB , and is laterally displaced. If DC is produced back to meet the normal through B at F , it may be easily proved that $n = BC/FC$ for all angles

of incidence. With a thick block of glass, the ray $ABCD$ may be traced out on a sheet of paper by placing pins at the points A , B , C , and D ; n may then be found by measuring BC and FC . The image of the pin at B is at F , and as the eye is moved from H at the surface to K on the normal, the image of B moves from G along GB , reaching a limiting position when B is viewed along the normal. The position of the image at F may be determined by trial, and the value of n found from GB/GF . In the latter case F lies a little nearer B than as shown in the figure.

When white light is refracted, it is also dispersed, since the different constituents of white light have different refractive indices (see *Dispersion*).

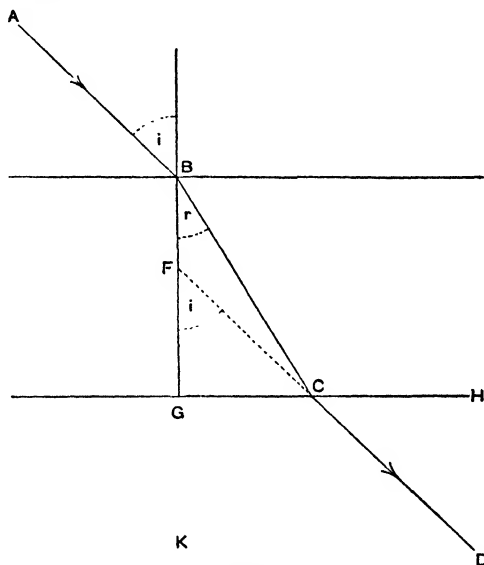


Fig. 3

Refraction of the sun's rays takes place as these pass through the atmosphere; this is caused by the gradual small change in the refractive index of air with density. There is thus a displacement in the apparent position of the heavenly bodies which requires to be allowed for in astronomical observations.

Double refraction is an effect produced on light by crystals which do not belong to the isometric system (see *Polarization of Light*).

Errors of refraction is a phrase applied to defects of eyesight which arise from deviations of shape and optical properties of the eye from those of the normal eye (see *Eye; Vision; Lens*).

Refractories, materials capable of withstanding high temperatures without fusing or softening, and used to a large extent in furnace

construction. They should be able to withstand the degree of heat required without altering their chemical or physical condition, and should prevent losses of heat by radiation and conduction. They should also possess a low coefficient of expansion and contraction, with sufficient hardness to prevent abrasion. For certain purposes they should resist chemical reaction on coming in contact with certain slags, &c., formed in the furnace. They are classified according to their chemical properties into acid, neutral, and basic materials. The acid materials are high in silica, and include Dinas rock and bricks, ganister, and most fire-clays. The neutral materials react with neither acid nor basic slags, and include graphite and chromite. The basic materials include magnesite and dolomite, and are used for lining basic Bessemer and open-hearth steel furnaces.

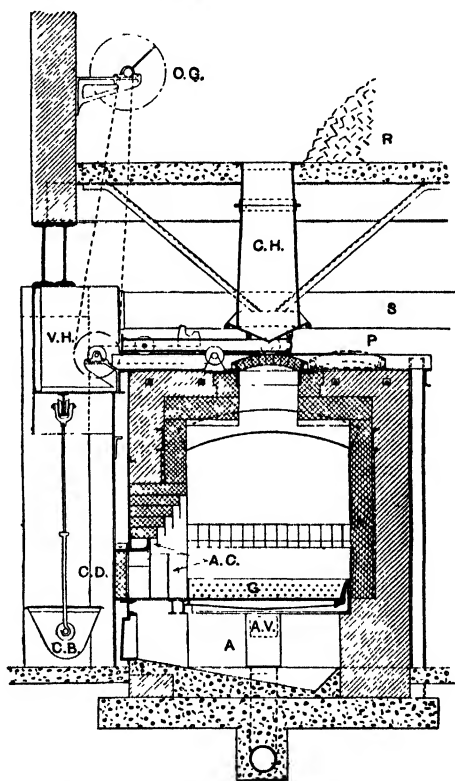
Refrigeration. See *Ice-making and Refrigeration*.

Refuse Destructor, a type of furnace in which the combustible refuse of cities is burned for the dual purpose of destroying it and making the heat it gives available for power production. The disposal of town refuse had always been a problem of considerable difficulty until this efficient method of destroying it was perfected. The ideal site for the plant is sloping ground beside a good road. The refuse is usually carted to the plant, and, if a clear run from the street to the tipping floor is available, the cost of handling the material will be low. Where a level run cannot be arranged, hoists are employed to convey the carts to the charging platform. The refuse is passed into the destructors continuously, and as it falls towards the fire-bars the temperature is raised by contact with the burning material. The air required for combustion is provided by the considerable draught created by a motor-driven fan. The burning gases are conducted through flues to the boilers, which are erected beside the plant. Dust collectors prevent the passage of unburnt materials to the outside atmosphere. In the process any decomposing or putrescent matter is converted into its harmless constituents—water vapour, nitrogen, and carbon dioxide. All combustible matter is burned, and the hard residue or clinker is available for such purposes as road-making and the manufacture of artificial flags for street pavements; or it is broken up to be used for mortar-making as a substitute for sand in places where there is little of the natural material available. The calorific value of refuse is about one-sixth of that of coal. The steam produced is commonly used to generate electricity for power or lighting in the neighbourhood of the plant, or to supplement the general city supply from the central station.

Regalia, the emblems or insignia of royalty. The regalia of England consist of the crown,

sceptre with the cross, the verge or rod with the dove, the so-called staff of Edward the Confessor, several swords, the ampulla for the sacred oil, the spurs of chivalry, and several other articles. These are preserved in the jewel-room in the Tower of London. The regalia of Scotland consist of the crown, the sceptre, and the sword of State. They, with several other regal decorations, are exhibited within the crown-room in the castle of Edinburgh.

Regent-bird, or King Honey-eater (*Sericulus melinus*), a very beautiful Australian bower-bird, belonging to the family Paradisidæ,



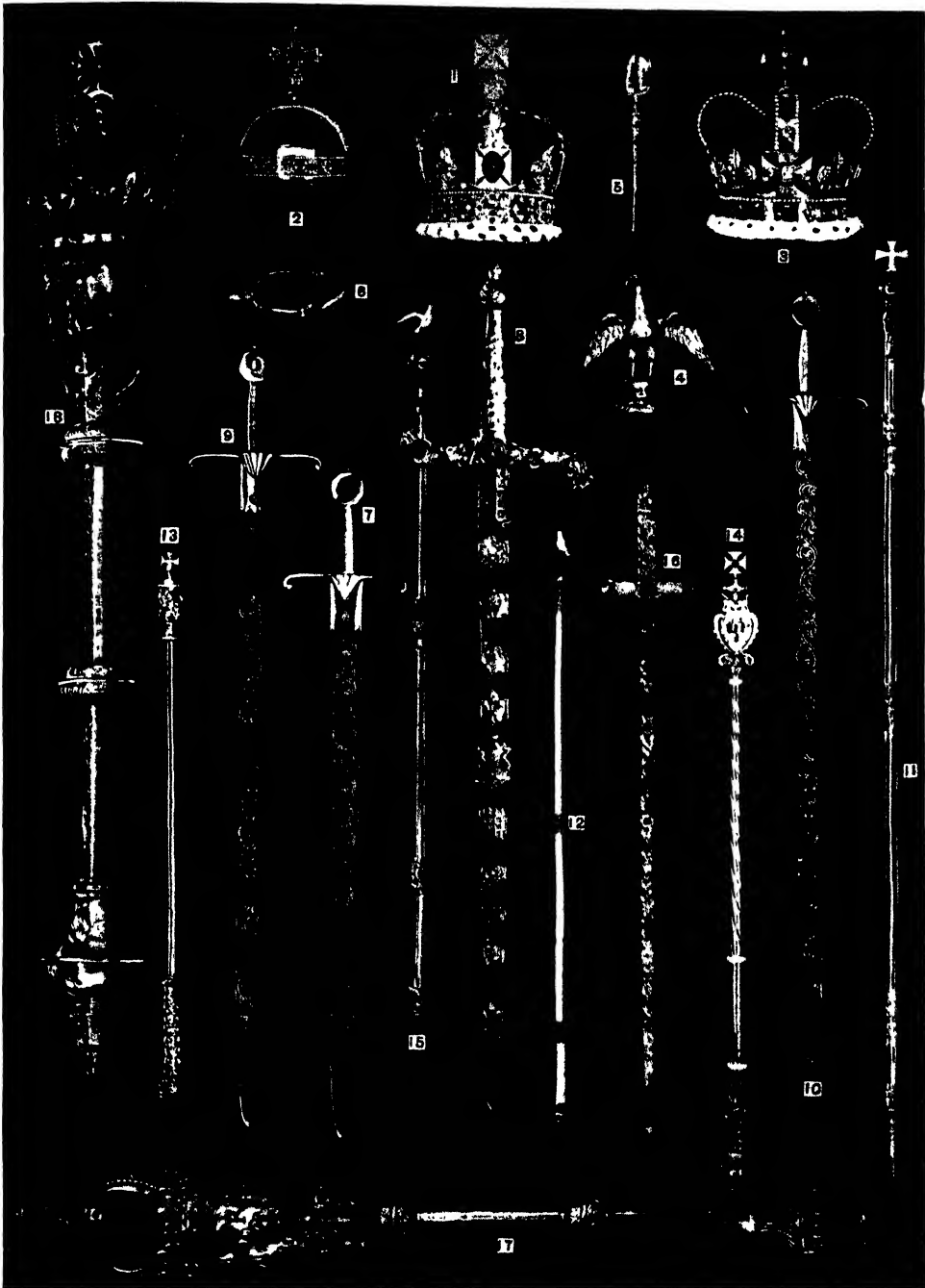
Cross-section of a 'Sterling' type Refuse Destructor. Mechanically fed. Reproduced by permission of Messrs. The New Destructor Co., Ltd.

OG, Operating gear to charging door. R, Refuse. CH, Charging hopper. P, Position of charging door when open. S, Suction duct to fan. VH, Ventilating hood. CD, Clinkering door. CB, Clinker bucket. AC, Air-cooled arch bar and jamb blocks. G, Grate. A, Ashpit. AV, Air valve.

which also includes the birds-of-paradise. The colour of the plumage is golden-yellow and deep velvety-black. It was discovered during the regency of George IV, and was named in compliment to him.

Regent's Park, situated in the north-west of

REGALIA OF ENGLAND



1. The Imperial Crown. 2. The Orb. 3. St. Edward's Crown. 4. The Ampulla. 5. The Anointing Spoon. 6. One of the St. George's Spurs. 7. The Curtana or Sword of Mercy. 8. The State Sword. 9. The Sword of Temporal Justice. 10. The Sword of Spiritual Justice. 11. St. Edward's Staff. 12. The Ivory Sceptre. 13. The Queen's Sceptre with Cross. 14. The Royal Sceptre. 15. The Sceptre with Dove. 16. The State Sword of Offering. 17 and 18. The Maces of the Serjeants-at-arms.

London, in the parishes of Marylebone and St. Pancras, comprises 470 acres. In the time of Elizabeth it was a royal hunting-ground. It received its present name when George IV was regent, having been planned at that time. A considerable portion of the ground is occupied by the Zoological Gardens, which are situated on the north of the park, and the Royal Botanic Gardens, which occupy its inner circle.

Reggio di Calabria, a maritime province of Calabria, Italy, the southernmost division of the Italian peninsula, on the Mediterranean. It has suffered much from earthquakes and from seismic waves following the shocks. Wine, oil, and silk are produced. Area, 1219 sq. miles; pop. 470,000.

Reggio di Calabria (ancient **Regium Iulium**), a city of Calabria, South Italy, capital of the province of Reggio, on the Strait of Messina; served by the coastal railways from Naples, &c. Linen and silk goods, pottery, and perfumes are made. Pop. 43,100.

Reggio Nell' Emilia, a province of Emilia, North Italy, lying mainly in the valley of the River Po. Cereals, fruit, wine, and oil are produced. Area, 885 sq. miles; pop. 326,500.

Reggio Nell' Emilia (ancient **Regium Lepidi**), a city of Emilia, North Italy, capital of the province of Reggio (Emilia); served by railway to Bologna (38 miles). Linen and silk are made; cattle and wine are traded. The town was founded about 187 B.C. After a prosperous career as an independent republic Reggio and district were definitely annexed to Piedmont in 1859. Pop. 75,350.

Regiment. In the British service this word is properly used to denote (a) a cavalry unit, (b) an association of infantry units or battalions, (c) the artillery as a whole as distinct from separate batteries in the Royal Regiment of Artillery. Colloquially the word is commonly used to describe any unit of cavalry or infantry. The word 'unit', used in this connection, means the 'tactical and administrative unit' of a given arm or branch of the service, which in the case of cavalry is a regiment, in that of infantry a battalion, and of artillery a battery.

A regiment of infantry normally consists of two regular battalions, one or more militia battalions, and all the Territorial battalions of the particular county or counties concerned, e.g. the Essex Regiment is shown in the Army List as follows:

THE ESSEX REGIMENT

Eastern Area.

REGULAR AND SPECIAL RESERVE BATTALIONS

1st Battalion (44th Foot). 2nd Battalion (56th Foot).
3rd Battalion (Essex (Rifles) Militia).

TERRITORIAL ARMY BATTALIONS

4th Battalion. 5th Battalion. 6th Battalion.
7th Battalion. 8th Battalion.

The appointment of colonel of a regiment of infantry, as opposed to that of a lieutenant-colonel commanding a battalion, is a purely honorary one, and entails few if any duties. It is given as a mark of distinction to senior officers who have at some time served with the regular battalions of the regiment. In some cases 'colonels-in-chief' are appointed in addition. Officers are gazetted to a regiment and not to a particular battalion; other ranks may, if they wish, enlist for a regiment; both officers and men are then 'posted' to whichever battalion requires them. The foregoing description does not apply to cavalry, where the regiment is, as we have shown, the unit for all purposes. See *Infantry*.

Regina, capital of the Canadian province of Saskatchewan, in the wheat belt; served by the transcontinental lines. It was formerly the head-quarters of the Royal Canadian Police, and capital of the North-West Territories. There are grain-elevators. Agricultural machinery, bricks, &c., are made; there are tanning and milling industries, and a Government-controlled creamery. Regina is the principal distributing point for the Middle West. Pop. (1922), 50,000.—*Cf. Heaton's Annual*.

Regiomontanus, German mathematician and astronomer, whose real name was Johann Müller, born at Königsberg, in Franconia, in 1436, died 1476. In 1471 he settled at Nürnberg, where, assisted by his pupil and patron, Bernhard Walther, he built and equipped the first European observatory. He returned to Rome on the invitation of Sixtus IV, who employed him in the reformation of the calendar. Regiomontanus was the first mathematician to publish a systematic treatise on trigonometry. He also published a table of tangents of angles, and was the inventor of the method of lunar distances for determining longitude at sea.

Registration of Births, Deaths, and Marriages. Parish registers of baptisms, marriages, and burials were instituted by Lord Cromwell while he was vicar-general to Henry VIII, and subsequently regulated by various Acts of Parliament. No thorough system, however, existed until in 1836 a Registration Act was passed applicable to England and Wales, which has been amended by subsequent Acts. When a birth takes place, it is the duty of the father and mother, or the occupier of the house in which the child is born, to give information to the registrar within forty-two days of the birth. In registering a birth the day on which the child was born must be given, the name (if any), the sex, the name of father and mother, and the signature, description, and residence of the informant. Violation of the law regarding the registration of births, e.g. by giving false

information, renders the party liable to a penalty of not more than £10. No fee is paid unless in case of undue delay. With regard to the registration of marriages, when they are solemnized in any Established church the officiating clergyman is required to fill up a register of prescribed form, giving the date of the marriage, the names and ages of the parties, whether married previously or not, rank, profession, or calling, residence at the time of marriage, name, surname, and rank or profession of the father of each of the parties. Marriages in other than Established churches must be similarly recorded. Deaths are registered much in the same way as births and marriages, the name, sex, age, profession, cause of death, &c., being stated according to a prescribed form. Within five days of the death the necessary particulars must be furnished to the registrar by the nearest relative of the deceased or other person present at the death. If a written notice of the death and a medical certificate of the cause of death are sent to the registrar, full particulars need not be given before fourteen days. The Irish system of registration of births, deaths, and marriages (1864) is similar to that of England and Wales. In Scotland the system was introduced by the Act of 1854, which provides for the establishment of a uniform scheme of registering births, deaths, and marriages. The giving of information is made obligatory, penalties being imposed for neglecting or refusing to give information, or for giving false information. Similar systems of registration exist in other countries. The registration of births, deaths, and marriages in the United States is subject to State legislation, not that of Congress.

Registration of Electors (Parliamentary) was first established by the Reform Act of 1832, in terms of which, in England, the overseers of each parish were required to draw up a register of all persons qualified to vote. This still forms the basis of procedure, but the law has been frequently altered, notably in the Representation of the People Act (1884) and the Registration Act (1885), now superseded by the Representation of the People Acts (1918 to 1922). Under instructions from the registration officer (who is the clerk to the county council in counties, and the town clerk in boroughs) the overseers of the parish are now required to publish yearly on the 17th January and 15th July lists of the qualified voters for the spring and autumn registers to come into force on the 15th April and 15th October respectively, and those persons not on the lists must apply to have their names inserted before the 11th February and 11th August. Any person on the registers may object to any person on these lists, but he must give notice to this effect. The decision of the registration officer

on any claim or objection may be appealed to the county court, from which a further appeal on a point of law may be taken to the Court of Appeal. The list of voters being thus settled, it is printed and handed to the returning officer. In Scotland the register of voters is drawn up by the county and burgh assessors, and the duties connected with revision on appeals are discharged by the sheriff of the county and the Court of Session. The lists are published on 1st February and 1st August, and the last days for claims are 15th February and 15th August. In Ireland the clerks of the Crown and peace for the administrative counties and county boroughs have charge of the registers, and revision on appeals is made by revising barristers (q.v.) or by the county court and the Court of Appeal. The lists are published on 1st September, and claims require to be lodged by 18th September.

Regium Donum, an annual grant of public money formerly given in aid of the income from other sources of the Presbyterian clergy in Ireland. It began under Charles II in 1672, was renewed under William III and subsequently augmented, until a considerable part of the means of support of the Presbyterian clergy was drawn from it. It subsequently amounted to £40,500, but the grant was withdrawn in 1869, a lump sum of £713,000 being given instead.

Regnault (rè-nô), Henri Victor, French chemist and physicist, born 1810, died 1878. He was educated at the École Polytechnique, Paris; became professor of chemistry at this institution in 1840, and professor of physics at the Collège de France the following year; chief engineer of mines in 1847; and director of the porcelain manufactory at Sèvres in 1854. His early work was in chemistry, and it was as a chemist that he was elected to the Academy of Sciences in 1840, but after 1841 he gave all his attention to physics, his researches in which are among the most notable in the history of the science. His experimental results in thermometry, specific heat, expansion of gases, and hygrometry were regarded as standards for many years. In 1845 Lord Kelvin, then William Thomson, worked for some months as a pupil in Regnault's laboratory.

Regulator, a device used in connection with engineering plant to maintain automatically a predetermined condition of running. The term is perhaps most commonly applied to mechanisms for the control of speed, but is also used in reference to arrangements for keeping the water-level in a boiler at some constant height, and for devices used to change the speed of electric motors (see *Rheostat*).

Supplementary controlling forces to the weight of the balls in governors have been adopted, such

as the use of an extra load mounted on the governor sleeve (introduced by Porter), and the use of springs. Speed-regulating devices on the main shaft of the engine are used in some types of high-speed engines. They are commonly arranged so that two revolving masses of metal change position under the action of centrifugal force, which is kept within reasonable limits by the controlling force made up of their own weight and the actions of springs. The net movement produced is used to change the throw and angle of setting of an eccentric, which controls the valve travel, and so gives a variable point of cut-off in much the same way as in the process of linking up a valve gear (see *Valves and Valve Gear*). The manner in which the regulation of speed in a four-valve type of engine is effected is described in the article *Steam-engine*.

The running of the Pelton type of water-wheel (see *Turbines, Water*) is regulated by means of devices known as *spear* and *deflector regulators*. In the spear type a shaft with a conical spear-head passes into the nozzle. The governor is made to change the position of the spear-head and thus close up to a greater or less extent the opening through the nozzle, reducing or increasing the amount of water passing through to the buckets on the wheel. In the deflector system a vane is drawn down into the jet, deflecting the water from its normal course to an extent dependent upon the deviation from the normal speed.

Feed-water regulators are devices in which the fall in the level of the water in a boiler is used to operate a valve which passes steam to the feed-pump, which operates until the level is normal again.

Devices to control the temperature of dyes, rubber-vulcanizing plants, and other vessels or chambers are commonly used in industrial work. One principle on which such instruments work is the production of vapour from a liquid which is easily vaporized. Every change of temperature of such a substance in a closed vessel is accompanied by a change of vapour-pressure. These pressures, operating behind a flexible diaphragm, are used to give the requisite motion to a mechanism controlling the opening of the valve which is used to admit the steam to the heated coils. The actual opening and shutting of the valve is commonly performed by the use of compressed air.

Regulus, Marcus Attilius, Roman general, who was made consul a second time in 256 B.C., and was engaged in a war with Carthage, in which he destroyed their fleet and landed his army in Africa. In the following year, however, he was defeated and taken prisoner by the Carthaginians. Sent to Rome on parole by his captors to negotiate peace, Regulus

patriotically persuaded his countrymen to continue the war and returned to captivity, where he died under torture.

Reid, Thomas, Scottish philosopher, born in 1710 at Strachan, Kincardineshire, died 1796. He was educated at Marischal College, Aberdeen, and in 1737 was presented to the living of New Machar in Aberdeenshire. In 1752 the professors of King's College, Aberdeen, elected Reid professor of moral philosophy in that college; and in 1764 he published his well-known work, *An Inquiry into the Human Mind on the Principles of Common Sense*. The same year he succeeded Adam Smith as professor of moral philosophy in Glasgow University, a position which he occupied until 1781. His other writings are *Essays on the Intellectual Powers of Man*, and *Essays on the Active Powers of the Human Mind*. His philosophy was directed against the principles and inferences of Berkeley and Hume, to which he opposed the doctrine of Common Sense. He was the founder of what is known as the Scottish School of Philosophy, in which he was followed by Dugald Stewart and Sir William Hamilton. In France also his doctrines were adopted by several eminent philosophers, such as Royer-Collard, Jouffroy, who translated Reid's works into French, and Victor Cousin, who gave a résumé of Reid's philosophy in his *Philosophie Écossaise*.—Cf. A. C. Fraser, *Thomas Reid*.

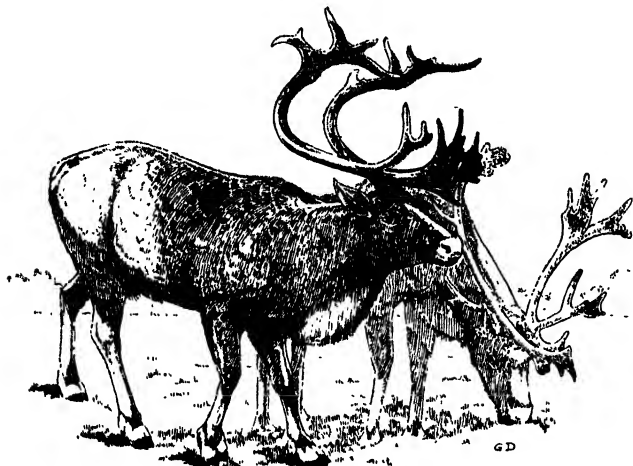
Reid, Captain Thomas Mayne, novelist, born in the north of Ireland in 1818, died 1883. His works include *The Rifle Rangers*, *The Scalp Hunters*, *The War Trail*, and *The Headless Horseman*.

Reigate (rî'gät), a municipal borough of England, county of Surrey; served by the South-Eastern & Chatham Railway. Pop. (1921), 28,920.

Reikiavik, or **Reykjavik** (rîk-yà-vîk'), a seaport, and the capital of Iceland, on the southwest coast. Pop. 17,980.

Reindeer (rân'dêr), a species of deer found in the northern parts of Europe and Asia, the *Rangifer tarandus*. It has branched, recurved, round antlers, the summits of which are palmed; the antlers of the male are much larger than those of the female. These antlers, which are annually shed and renewed by both sexes, are remarkable for the size of the branch which comes off near the base, called the brow tine. The body is of a thick and square form, and the legs shorter in proportion than those of the red-deer. Their size varies much according to the climate, those in the higher arctic regions being the largest; about 4 feet 6 inches may be given as the average height of a full-grown specimen. The reindeer is keen of sight, swift of foot, being capable of maintaining a speed of

9 or 10 miles an hour for a long time, and can easily draw a weight of 200 lb., besides the



Reindeer (*Rangifer tarandus*)

sledge to which they are usually attached when used as beasts of draught.

Reindeer Moss, a lichen (*Cladonia rangiferina*) which constitutes almost the sole winter food for reindeer, &c., in high northern latitudes, where it sometimes attains the height of 1 foot. It is also found in the moors and mountains of Britain. Its taste is slightly pungent and acrid, and when boiled it forms a jelly possessing nutritive and tonic properties.

Reinforced Concrete. According to tradition, ancient Roman builders used concrete reinforced with chains and pieces of metal for certain types of construction; but the actual invention of reinforced concrete as we know it to-day is generally ascribed to M. Joseph Monier, who, in 1861, constructed small tanks of concrete reinforced with wire. In 1867 M. Coignet, along with M. Monier, constructed some reinforced concrete work at the Paris Exhibition. For some time it was left to German and Austrian engineers to prove the capabilities of reinforced concrete, but to France belongs the principal credit for the most important developments in present-day design and theory. These developments are associated with the names of MM. Coignet, Hennebique, and Considère.

The term 'reinforced concrete' now stands for a combination of steel reinforcing bars embedded in concrete. Steel is strong in resisting tension, and is able to carry about 300 times the tensile stress that can be carried by an equal sectional area of concrete. Concrete is strong in resisting compression, but is relatively weak in withstanding tension, the breaking stresses in the

two cases being in the ratio of about 10 to 1. The concrete consists of cement and 'aggregate'

in definite proportions, the usual proportions by volume being 1 part of cement to an aggregate of 2 parts of sand and 4 parts of hard broken stone. The necessary water required for mixing is about 5 gallons to every 100 lb. of cement. The ultimate compression strength of concrete mixed in these proportions is about 2000 lb. per square inch when one month old, and about 3000 lb. per square inch when six months old. A simple unreinforced concrete beam under an increasing load would fail at the under side of the beam, owing to tension stresses, long before the compressive resistance in the top of the beam had fully developed. Steel rods should therefore be embedded in the concrete as nearly as possible along the lines

of the tension stresses in the beam, and should be of sufficient sectional area to develop the same strength in tension as that of the concrete in compression along the top portion of the beam. In economical construction tension stresses are resisted by the steel, and compression stresses by the concrete.

Steel and concrete act in unison for the following reasons:

1. The coefficients of expansion of steel and concrete are practically the same, so that changes of temperature do not break the adhesion of the concrete to the steel.

2. Concrete when setting contracts slightly and grips the steel rods firmly, thus preventing the rods being pulled away from the concrete when under stress.

3. Concrete resists decay, its strength increases with age, and, if properly applied, it effectually protects the steel against the actions of the elements, as it is practically watertight.

Reinforced concrete construction has had a wonderful and rapid development, more particularly within the last ten or fifteen years. With the introduction of regulations relating to design and construction, the London County Council have established a standard for design in general, but, owing to the adaptation of this material to countless types of construction, the actual design of reinforced concrete work is chiefly in the hands of specialists.

The following are some types of construction for which reinforced concrete is suitable: buildings and foundations, chimneys; arched and girder bridges for road or railway traffic; wharves

and jetties, docks and harbours; granaries and silos; reservoirs and water-towers; sewers, culverts, and water-pipes; hoppers and bunkers; retaining walls and dams; tunnels.

Recently reinforced concrete pipes have been made by centrifugal action by spinning the concrete in moulds. Such pipes are able to resist considerable water pressure, the centrifugal action ensuring the most impervious and dense concrete at present known.—BIBLIOGRAPHY: Marsh and Dunn, *Reinforced Concrete Manual*; Turneaure and Maurer, *Reinforced Concrete Construction*; Hool and Johnson, *Concrete Engineers' Handbook*; Taylor and Thompson, *Concrete, Plain and Reinforced*; L.C.C. *Regulations on Reinforced Concrete* (with explanatory notes by E. S. Andrews).

Relapsing Fever, or Remittent Fever, is an acute fever characterized by recurrent feverish attacks of about one week's duration, followed by a period of no fever. High temperature, vomiting, and headache are followed later by diarrhœa, hæmorrhages, bronchial troubles, and eye complications, while in severe cases delirium with maniacal outbursts may occur.

Relativity. This theory may be broadly described as an attempt to co-ordinate and explain the known results of physical science, and to predict new phenomena, on the basis of the assumed general principle that the only motion which we are capable of observing is relative motion, and consequently relative motion is the only kind of motion which need be considered in investigating and describing the laws of nature. Any statement of a law of nature, therefore, which implies that we *can* observe absolute motion is contrary to the principle, and is denied. Einstein extends this principle to the laws of electricity and light, and finds that, if it is to apply to the phenomena of electricity and light, as well as to those of mechanics, the Newtonian laws of motion must be modified. The effect is negligible in all cases of motion at ordinary speeds, but becomes appreciable in certain astronomical phenomena and in electro-dynamics and optics.

As a method of discovery of physical laws, the theory is distinctly reminiscent of the well-known principle of dimensions (see *Dimensions, Physical*). In both cases there would seem to be some underlying but recondite principle, by taking advantage of which we may often arrive at definite numerical laws governing phenomena without in any way taking account of the machinery by which the phenomena are produced.

Einstein has stated the principle in the following words: "If, relative to K, K¹ is a uniformly moving co-ordinate system devoid of rotation, then natural phenomena run their course with respect to K according to exactly the same

general laws as with respect to K¹. This statement is called the *principle of relativity* (in the restricted sense)." The principle, of course, was known and had been clearly stated in one form or another long before Einstein's time. Take, for example, the following quotation from Clerk Maxwell's *Matter and Motion* (1877).

"If every particle of the material universe within the reach of our means of observation were at a given instant to have its velocity altered by compounding therewith a new velocity, the same in magnitude and direction for every such particle, all the relative motions of bodies within the system would go on in a perfectly continuous manner, and neither astronomers nor physicists, though using their instruments all the while, would be able to find out that anything had happened."

As an example of the meaning of the principle, we may take the case of two lifts moving vertically downwards towards the ground at speeds constant for each but not the same for both. These speeds are supposed to be measured relative to the ground. If two observers, one in each lift, made experiments on the laws governing the falling of a stone, say, each in his own lift, they would find identical results; each would say that his stone fell with a constant acceleration of 32·2 feet per second per second. In the same way, according to the principle of relativity, all the laws of nature, and in particular the laws of light and electricity, as well as the laws of dynamics, would be the same for any two observers in lifts moving with constant relative velocities.

The earlier form of the theory of relativity—the *special* theory of Einstein—originated in connection with the celebrated Michelson-Morley experiment, which seems to prove that every observer estimates the velocity of light at the same value, whatever his own velocity may be.

Consider two observers moving along the axis of x , the second at rate v relative to the first. Relative to the two observers, at O and O', say, let (x, t) and (x', t') be the length and time co-ordinates of one and the same event. Then, according to Galileo and Newton,

$$\left. \begin{aligned} x' &= x - vt, \\ x &= x' + vt', \end{aligned} \right\} \quad (A)$$

whence $t' = t$.

In this system (A) there is no finite velocity which appears to the two observers to have the same value. But if we assume the more general relations,

$$\left. \begin{aligned} x' &= \beta(x - vt), \\ x &= \beta(x' + vt'), \end{aligned} \right\} \quad (B)$$

we can find one velocity c —taken as the velocity of light—such that $x = ct$ and $x' = ct'$ to—

gether; for we find that the equations (B) are satisfied by these values of x and x' provided

$$\beta = \frac{1}{\sqrt{1 - v^2/c^2}}.$$

If in (B) we put $t = 0$, we get $x' = \beta x$; and if we put $x' = 0$, we find $t = \beta t'$. Thus a length judged to be x' by the observer O' is taken to be x'/β by O ; and a time which O' estimates as t' is considered to be $\beta t'$ by O .

The equations (B) are equivalent to what is known as the Lorentz transformation. They were found by Larmor and Lorentz as the typical formulæ of linear transformation under which the equations of electrodynamics, and consequently the velocity of light, remain unaltered. The interpretation of them just indicated is due to Einstein.

On this theory the place and time of an event, considered separately, are relative to the observer. It is only the event itself, the combination of place and time, that is absolute. The idea has been expanded by Minkowski into an elaborate theory of space-time, the four dimensional continuum of events. The 'interval' ds between the events (x, y, z, t) and $(x + dx, y + dy, z + dz, t + dt)$ may be given by the equation

$$ds^2 = dt^2 - dx^2 - dy^2 - dz^2,$$

in which case space-time is analogous in its metrical relations to ordinary Euclidean space. In the most general case, if x_1, x_2, x_3, x_4 be co-ordinates of any system whatever defining an event, we have

$$ds^2 = g_{11}dx_1^2 + \dots + 2g_{12}dx_1dx_2 + \dots$$

a homogeneous quadratic function of the differentials, the functions g being arbitrary functions of x_1, x_2, x_3, x_4 .

Einstein's *general* theory of relativity, by which he explains gravitation, is based on the hypothesis that the 'natural' path of an event is along a geodesic in this space-time. The form of such a geodesic depends on the nature of the functions g . These cannot be entirely arbitrary, and may be expected to satisfy differential equations, which will embody the 'law of gravitation'. The differential equations must in the nature of the case be of invariant form for all transformations of the co-ordinates x . The theory of such invariant forms is known from the researches of the cultivators of differential geometry, from Riemann and Christoffel onwards. By equating certain selected invariants to zero, Einstein obtains 10 differential equations for the 10 functions g in free space-time. These are satisfied for the form

$$ds^2 = -\frac{1}{\gamma}dr^2 - r^2d\theta^2 + \gamma dt^2,$$

where $\gamma = 1 - 2m/r$, and reasons are given for inferring that this form represents the character of space-time round a particle of gravitational mass m .

By integrating the equations for a geodesic, the equation is obtained

$$\left(\frac{du}{d\theta}\right)^2 + u^2 = \frac{c^2 - 1}{h^2} + \frac{2mu}{h^2} + 2mu^3, \dots (1)$$

where $u = 1/r$, and c, h are constants of integration. This leads at once to

$$\frac{d^2u}{d\theta^2} + u = \frac{m}{h^2} + 3mu^3, \dots (2)$$

which differs from the well-known equation for the orbit of a planet on the Newtonian theory only by the addition of the small term $3mu^3$.

Again, for the path of a light ray, $ds = 0$ and $h = \infty$, so that

$$\frac{d^2u}{d\theta^2} + u = 3mu^3, \dots (3)$$

It is now a matter of comparatively simple mathematics to deduce from (2) the hitherto unexplained advance of 43'' per century in the perihelion of Mercury; and from (3) a deflection of 1.74'' in the path of a light ray from a distant star passing close to the edge of the sun.

It is to the sensational verification of this predicted deflection, obtained from observations of the eclipse of the sun on 29th May, 1919, that the present widespread public interest in Einstein's remarkable theory is due.

Is Einstein's theory 'true' then? It certainly satisfies some of the tests of the value of a scientific theory. It has explained facts hitherto unexplained, and it has predicted results which have been verified by experiment. At the same time there are difficulties. One has reference to centrifugal force. A body rotating relatively to surrounding bodies shows certain effects associated with the centripetal accelerations of its particles. The principle of relativity would lead us to infer that the same effects would be produced if the outside bodies rotated about the other. This is quite contrary to ordinary notions, very difficult to grant, and, so far at least, unsupported by experiment.

Again, Einstein has pointed out as another consequence of his theory of gravitation that the lines of the solar spectrum ought to be displaced towards the red by a certain definite amount as compared with the same lines in a terrestrial spectrum. This prediction has been put to the test of experiment, but with indecisive results.

It may be noticed that Einstein's theory does not, any more than Newton's, explain the physical cause of gravitation. Many people will

not be satisfied with an 'explanation' of nature which is essentially a mathematical one, and which, for its full expression, invokes a 'world' of four dimensions, one dimension of which is measured by a co-ordinate of 'time' expressed as an *imaginary* number; convenient though this conception may be mathematically, no clear mental picture can be formed of processes going on in such a world—thought appears to be impossible except through the medium of mathematical symbolism. — BIBLIOGRAPHY: A. Einstein, *The Theory of Relativity*; A. S. Eddington, *Space, Time, and Gravitation*; *Report on the Relativity Theory of Gravitation* (Physical Society of London); E. Cunningham, *The Principle of Relativity*; H. Weyl, *Space, Time, and Matter*; Viscount Haldane, *The Reign of Relativity*.

Relativity of Knowledge, a philosophical doctrine which teaches that knowledge is only relatively true. It insists on the distinction between objects as they are and objects as we see or know them, between the 'noumenon' and the 'phenomenon'. According to this doctrine, the reality or essence of things is altogether unknown to us. All our knowledge consists merely of impressions: 'we know only phenomena'. And these impressions may differ for different people, as we see actually to be the case in matters of taste, smell, colour-perception, &c.; and of course the difference is still greater as between man and the lower animals. Hence there is no such thing as absolute knowledge; all knowledge is relative. The doctrine of relativity of knowledge dates back to Protagoras, who taught that "man is the measure of all things", but the theory has been especially advanced by Kant, Sir William Hamilton, and Herbert Spencer.

Relics, remains of saints and martyrs or objects connected with them, and especially memorials of the life and passion of our Lord, to which worship or a special veneration is sanctioned and practised both in the Roman Catholic and Greek Churches. The doctrine of the Roman Catholic Church in regard to relics was fixed by the Council of Trent, which decreed in 1563 that veneration should be paid to relics as instruments through which God bestows benefits on men; a doctrine which has been rejected by all Protestant Churches. The veneration of relics is not peculiar to Christianity, but has found a place in nearly every form of religion. Buddhism, with whose theoretical doctrines relic-worship has as little to do as with those of Christianity, is remarkable for the extent to which relic-worship has been adopted by it. In the Old Testament Scriptures relic-worship is noticed as one of the superstitious practices associated with idolatry, against

which the prophets and reforming Kings of Israel and Judah were continually at war. The origin of relic-worship or veneration in the Christian Church is generally associated with the reverence paid by the early Christians to the tombs of the martyrs and to objects associated with their memory. Roman Catholics believe that relics are sometimes made by God instruments of healing and other miracles, and that they are capable of bestowing spiritual graces. The Council of Trent required bishops to decide on their authenticity. In course of time great abuses grew up in regard to relics; and it is scarcely necessary to add that the articles venerated as relics multiplied beyond measure. Not only did those of which the supply was necessarily limited, as the wood of the true cross and the relics of apostles and early martyrs, become common and accessible to an astonishing degree, but the most puerile and even ridiculous objects were presented as fitting symbols for veneration from their association with some saint or martyr, and were credited with the most astounding miracles. Such abuses have been greatly modified since the Reformation. Gibbon (*Decline and Fall*, chapter xxviii) has summarized the progress of relic-worship, the superstitions and corruptions associated with it, and its important consequences in the history of the Church.

Religion. To define 'religion' may be impracticable, but the various attempts to reach a definition are valuable, since they throw light upon the meaning attached by various thinkers to the term. As it stands, the word represents a Latin term *religio*. The Romans were the least religious of the great nations in antiquity, yet it is to them that we owe the word, which was derived either from *relegere*, to re-read or reflect, or from *religare*, to bind. Such are the two possible origins of the term. Either religion meant a careful reflection upon the nature and requirement of the gods, as opposed to the careless attitude of superstition; or else it denoted a bond of obligation which held man to the gods. The etymology remains obscure. But, whether the second derivation is accurate or not, it denotes one of the essential ideas in religion, viz. that of obligation. Dependence upon higher powers, and a sense of obligation to them, seem vital to religion, and a number of the better definitions undertake to bring this out. A definition like that of Schleiermacher—"the consciousness of contact between the soul and the universe"—is too narrow. So is Max Müller's, that "religion consists in the perception of the infinite under such manifestations as are able to influence the moral character of man". The truer line is indicated by Sir J. G. Frazer, to whom religion is "a propitiation or

conciliation of powers superior to man, which are believed to direct and control the course of nature and of human life". Similarly, Dr. Allan Menzies argues that religion is "the worship of higher powers from a sense of need", and Dr. Jastrow proposes "the natural belief in a Power or Powers beyond our control, and upon whom we feel ourselves dependent"; Durkheim suggests, "a religion is a unified system of beliefs and practices relative to sacred things, that is to say, things set apart and forbidden—beliefs and practices which unite into one single moral community, called a church, all those who adhere to them"; and Loisy similarly emphasizes the collective social aspect in his *Essai historique sur le sacrifice* (1921, page 5), where he declares that "religion is the entirety (*l'ensemble*) of the ideas, customs, and practices by which men living in society consider they are placed in normal contact with the higher powers or principles on which they believe themselves to depend". Some definitions are too vague, e.g. "morality touched with emotion" (Matthew Arnold); "veneration for the power which exercises a dominant influence over life" (Frederic Harrison); or "man's whole bearing toward what seems to him the Best or Greatest" (G. M. Stratton, *Psychology of the Religious Life*, 1911). Even Jean Réville's definition (in *Liberal Protestantism*) of religion as "essentially a principle of life, the feeling of a living relation between the human individual and the powers or power of which the universe is the manifestation", is too restricted, and ignores the social aspect entirely. On the other hand, some definitions are too definite, and by their very height exclude some real though inferior forms of religion; as e.g., Bishop Butler's, that religion is "the belief in one God or Creator and Moral Governor of the World, and in a future state of retribution", or Dr. Martineau's, that religion is "belief in an everlasting God, that is, a divine mind and will ruling the universe and holding moral relations with mankind".

Religion contains belief, but it is more than a belief. It implies certain convictions about the universe and the power or powers which are supposed to lie above and behind nature and human nature. These convictions are rooted in the soil of a natural curiosity, but curiosity does not account for the worship which is vital to religious belief. This worship involves emotion, though religion is never a mere emotion, even of dependence. It expresses itself in a variety of forms, all of which imply a sense that the worshipper is indebted to the god or gods, that he seeks to maintain or regain relation with them, and that he recognizes an obligation resting upon himself in this relationship with the supernatural. To put it otherwise, the

religious instinct is always found within a sense of the supernatural which stirs awe or terror, wonder, interest, fascination, and even love; the impulse to enter into communication with this supernatural power, by means of sacrifice and prayer, involves a corresponding sense that thereby the worshipper comes under certain laws or binding prohibitions issuing from the deity, the observance of which is essential to the maintenance of fellowship.

According to the varied stages of civilization, this instinct assumes many forms, which are determined by racial and even geographical environment. Thus, the conception of the supernatural power or powers tends to determine the practices of the religion; where the emotion of terror and fear is uppermost, a rite like human sacrifice or bodily mutilation will prevail, in order to propitiate and conciliate the angry deity. Countries where fertility of nature is predominant will develop a religion which associates the divine with the processes of birth, growth, and death. It is owing to this conviction that during the past century increasing attention has been paid to the study of comparative religion, particularly in the sphere of anthropology, where the study of primitive man has led to fresh light being thrown upon religious phenomena in their initial and original phases. But the essence of religion is not to be found simply in an analysis of savage rites and beliefs, any more than a study of government would confine itself to an analysis of primitive clan life. At the same time, the investigations of recent anthropology and folklore have contributed materially to our knowledge of how religion came into exercise. They raise the vexed question of the origin of religion, for example. Was it in magic, or independent of magic? Magic is a vague word, as used by moderns in their evolutionary consciousness, but it denotes certain recognized acts and rites in primitive civilization, and primitive religion is constantly associated with it. The question is whether magic is a debased form of the religious instinct, or, as Sir J. G. Frazer holds (*Golden Bough*, 3rd edition), prior to religion, or, as W. Wundt and others argue, identical with the lowest forms of religion. The ablest opposition to Frazer's theories is that of A. Lang in his books *Magic and Religion* and *The Making of Religion*, though Lang's idea of a pure, pristine stage of religion, followed by a degeneration, has not won acceptance. What the investigations into primitive religion appear to have disproved is, on the one hand, the existence of any primitive natural religion, and, on the other hand, the impossibility of referring religion to anything like a sense of the infinite. From the first it has been bound up with man's conception, crude enough, of the mysterious natural world. Whether

it originated in dreams, or in the notion of ghosts, with the worship of dead ancestors, or in animism, i.e. in the personification of natural powers and objects which attributed spirits to them, is still disputed, although the tendency is to abandon theories which regard ancestor-worship or animism as more than early and rudimentary expression of the religious feeling.

As to the fundamental nature of religion, when defined carefully, it seems probable that it was universal, or almost universal, in the ancient world. The most thorough examination of this subject, by Professor Robert Flint in his *Anti-Theistic Theories* (chapter vii), converges on the conclusion that no entire tribes or nations can be proved to have been destitute of some religious beliefs, and that even "although Buddhism should be logically resolvable into atheism, although its fundamental principles should be shown logically to involve atheism, Buddhists are not to be described as atheists".

The idea of development has been particularly fruitful in elucidating the variety of religious phenomena. The general evolution has been from tribal to national, and from national to denationalized religion. These stages are marked even within the history of a single form of religion. The strain of the process accounts for the presence of 'survivals' in a religion; for religion is essentially conservative, especially in the expression of its rites and beliefs, and progress is generally marked by an attempt to retain as much as possible of the old, even in advancing to wider conceptions under the stress of larger experience. The factors of change in religion are generally due to historical, scientific, and philosophical changes in the social nexus. The reactions set up are repeatedly the cause of restatement and resetting, in which the ethical and ritual elements of religion are more or less profoundly affected. Fundamentally, religion embraces the three ideas of the soul, the world, and the deity. The idea of the deity may vary; it may be more or less personal, and in some religions, e.g. Buddhism, it may be vague, just as in others it may be polytheistic. But, apart from such variations, these three conceptions are essential, and, as the advance of knowledge compels a fresh analysis of the human soul and of the world, the result is an impact upon traditional statements of religion. Hence the problems connected with superstition, ritual, and theology, as well as the problems of the relation between religion and morality or science. The varieties of religion are still further affected by temperament, national and individual. But such varieties are a fresh proof of vitality. The problem of finding among them what is essential to religion remains; the conclusion that religion in some form is essential to human nature appears to be

made out. Réville defines religion as "the determination of human life by the sentiment of a bond uniting the human mind to that mysterious mind whose domination of the world and of itself it recognizes, and to whom it delights in feeling itself united" (*Prolegomena to the History of Religions*, English translation, 1884). In primitive ages 'influencing' would correspond to the facts rather than 'determination', and, though fear did not make religion, yet 'delight' is too strong a term to cover the response of the human soul to the deity. Nevertheless, some description like this would cover much the greater part of the evidences for religion in history. It enables us to recognize religion, wherever we find it, in lower or higher forms of civilization, and to understand how it has been and must be dominant, an ineradicable instinct which is capable of readjusting itself to any fresh phase of the civilization of the race.

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Religious Denominations. The table on p. 368 shows the approximate number of adherents of the most prominent religions, and their continental distribution:

	Europe.	Asia.	Africa.	North America.	South America.	Australasia.	Total.
Roman Catholic ..	183,760,000	5,500,000	2,500,000	36,700,000	36,200,000	8,200,000	272,860,000
Orthodox ..	98,000,000	17,200,000	3,800,000	1,000,000	—	—	120,000,000
Protestant ..	93,000,000	6,000,000	2,750,000	65,000,000	400,000	4,500,000	171,650,000
Total Christian ..	374,760,000	28,700,000	9,050,000	102,700,000	36,600,000	12,700,000	564,510,000
Jews ..	9,250,000	500,000	400,000	2,000,000	30,000	25,000	12,205,000
Mahommedan ..	3,800,000	142,000,000	51,000,000	15,000	10,000	25,000,000	221,825,000
Buddhist ..	—	138,000,000	11,000	—	—	20,000	138,031,000
Hindu ..	—	210,000,000	300,000	100,000	110,000	30,000	210,540,000
Confucian and Taoist ..	—	300,000,000	30,000	100,000	—	700,000	300,830,000
Shinto ..	—	25,000,000	—	—	—	—	25,000,000
Animist ..	—	42,000,000	98,000,000	20,000	1,250,000	17,000,000	158,270,000
Miscellaneous ..	1,000,000	6,000,000	130,000	8,000,000	—	150,000	15,280,000
Total Non-Christian } and Mahommedan }	14,050,000	863,500,000	149,871,000	10,235,000	1,400,000	42,955,000	1,081,981,000
Grand Total ..	388,810,000	892,200,000	158,921,000	112,935,000	38,000,000	55,625,000	1,646,491,000

Religious Tract Society, a society founded in London in 1799 (and incorporated in 1809) for the circulation of small religious books and tracts in foreign countries, as well as through the British dominions. The society disseminates publications in more than 250 languages, dialects, and characters. Its annual circulation from the depository in London and from various foreign societies is over 46 millions. Its publications are very varied, including tracts, Bibles, commentaries, works in defence of the Bible and against Romanism, stories, and popular science and natural history books.

Remainder, in law, is a limited estate or tenure in lands, tenements, or rents, to be enjoyed after the expiration of another particular estate. Thus A, the owner of an estate, grants it to B for his life (particular estate), with 'remainder' to C in fee. C succeeds on the death of B.

Rembang, a town of Java, in the residency of same name. Its harbour is one of the best in the island; it has a good trade in ship-timber and in shipbuilding, and near it are valuable salt-pans. Pop. 14,000; (residency), 1,250,000.

Rembrandt, in full, *Rembrandt Harmensz Van Ryn*, the most celebrated painter and etcher of the Dutch school, was born about 1606 at Leyden, where his father was a well-to-do miller, and died at Amsterdam in 1669. Early displaying a passionate love for art, he worked for three years under Van Swanenburch of Leyden, a painter of little note, and afterwards studied for a few months in Amsterdam under Pieter Lastman. But he had little sympathy with Lastman's Italian mannerisms, and returned home to take nature as his guide, finding his material in everyday life. In 1631 he removed to Amsterdam, which he never left again. In 1634 he married Saskia van Uilenburg, daughter of the burgomaster of Leeuwarden. Rembrandt has rendered her famous through numerous etched and painted portraits.

His paintings and etchings were soon in extraordinary demand, and he must have acquired a large income by his work, but his expenditure seems to have been greater. In 1642 his wife died; and this, with the failure of the so-called *Night Watch* (a painting of the City Company of Amsterdam issuing from their hall) to satisfy his clients, marked a decline in Rembrandt's fortunes. To financial disasters were added domestic trouble, his relations with Hendrickje Stoffels being the subject of much criticism. In 1656 he was declared bankrupt, his property remaining in the hands of trustees till his death in poverty and obscurity. Rembrandt excelled in every branch of painting, and his treatment of light and shade has never been surpassed. His works display profound knowledge of human nature, pathos, tragic power, humour, and poetic feeling. In portraiture especially, his penetration into character is almost unrivalled. Like his contemporaries, he drew his material from contemporary life; but transformed it by his imaginative power into something rich and new. His artistic development may be broadly divided into three periods. To the first of these (1627-39) belong many paintings of religious subjects; the well-known *Lesson in Anatomy*; and many portraits of himself and his wife, both in her own and in other characters, such as *Queen Artemisia*, *Bathsheba*, and *The Wife of Samson*. His middle period (1640-54) is represented by: *The Night Watch*, *The Woman taken in Adultery*, *Tobit and his Wife*, *The Burgomaster and his Wife*, *Descent from the Cross*, *Portrait of Coppenol*, *Bathsheba*, and *Woman Bathing*. In these Rembrandt is seen developing the imaginative power and technical mastery which were to bear fruit in his last period (1655-68), and are seen in *John the Baptist Preaching*, *Portrait of Jan Six*, *The Adoration of the Magi*, *The Syndics of Amsterdam*, *The Prodigal Son*, and *The Supper at Emmaus*, and in various portraits of himself. As an etcher,

in technique and power of suggestion Rembrandt has still to be equalled, and he remains one of the greatest masters of this art. Another important part of his work are his drawings, mainly executed in pen-and-ink, which show extraordinary freedom and economy of means. Rembrandt had numerous pupils, among them Gerard Dou, Bol, Flinck, and Macs; and his influence has been widespread and permanent. Almost every phase of his art can be satisfactorily studied in the great English collections; but a visit to Amsterdam is desirable for complete understanding. — BIBLIOGRAPHY: H. Rea, *Rembrandt*; H. Knackfuss, *Rembrandt*; A. S. Rappoport, *Famous Artists and their Models*; C. J. Holmes, *Notes on the Art of Rembrandt*; Emile Michel, *Rembrandt*.

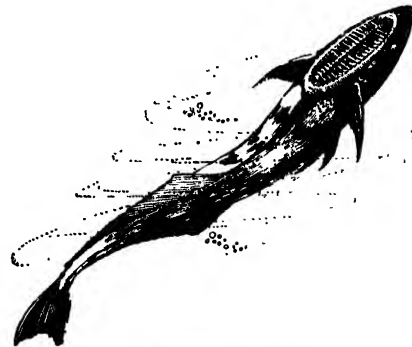
Remedial Exercises and Massage. The Arabic word from which 'massage' is derived signifies, according to Littre, not only pressure by the hands upon the muscular parts of the body, but the exercise of traction upon joints also. In this comprehensive sense, massage is the earliest and most elementary of all means for the relief of pain and the cure of disease. The lower animals lick, rub, and bite parts which have suffered injury; and in human society the use of these instinctive attentions has been from the earliest times recognized and intelligently elaborated. The dignity and value of the art notwithstanding, grave abuse has over and over again brought it into disrepute and neglect. Revived in Europe during the sixteenth century, massage owes its present high position in the estimation and practice of physicians and surgeons to the French, who have been its most constant exponents. The terminology of modern practice is essentially French. *Effleurage* consists in stroking towards the trunk with the finger-tips, the side of the hand, or the palm, whereby the return flow of blood by the veins is assisted and absorption by the lymph vessels of inflammatory effusions increased. Thus it is used in treating recent fractures to cause muscular relaxation and promote repair, certain injuries to and affections of the nerves, and frost-bite. *Friction* is a variety of effleurage familiarized by common association with the application of oils and embrocations, to which, rather than to the rubbing itself, benefit is often falsely attributed. Friction accelerates the local circulation and stimulates the tissues. Its uses are numerous. By *pétrissage* is meant the raising of the tissues, skin, and muscles, and the kneading of them between the fingers, or the application of rolling movements to a limb held between the hands. Its uses are more specialized than those of friction. *Tapotement* is percussion with the finger-tips (punctuation), the side of the hand (hacking), the palm (clapping), or the fist

(beating). It is used for the relief of fatigue and stiffness, and in the treatment of chronic rheumatism and cases of paralysis which have improved under less vigorous measures.

In debility, obesity, and anæmia graduated exercises are valuable adjuncts in treatment; in spinal curvature of muscular origin appropriate exercises correct deformity by traction, and maintain improved posture by strengthening the muscles; in certain diseases of the heart and lungs breathing exercises are valuable; exercises which involve conscious muscular co-ordination are part of the 're-education' of functions impaired by nervous diseases, such as locomotor ataxy; neurasthenic cases are improved by exercises which involve nervous concentration; while the respiratory muscles may be strengthened or a collapsed lung expanded by blowing exercises. Even hard work is not without its curative uses. Massage has a wide but not an unlimited field. The very act which soothes pain and promotes healthy function may as easily disseminate a malignant growth or reinfect with the bacillus of tuberculosis.

Remiremont (rè-mër-mon), a town of France, in the department of the Vosges, picturesquely situated at the foot of the Vosges, on the left bank of the Moselle. It is famous for its ancient abbey, and has manufactures of muslin, lace, &c., with a considerable trade, principally in cheese. Pop. 10,500.

Remonstrance, The Grand, a protest presented to Charles I by the Long Parliament in Nov., 1641, demanding securities for the non-recurrence of the ill-government which it pointed out. The king, through his adherents, resisted the measure to the utmost, but it was passed by a majority of eleven. Charles endeavoured to arrest the five chief members concerned, in the following January, and on his failure soon raised the standard of civil war.



Remora (*Remora brachyptera*)

Rem'ora, a genus of spiny-finned fishes, which, together with the closely allied Echenis, makes

up a special family (Echeneididae), of which the common remora (*Remora brachyptera*), or sucking-fish, is the typical example. These fishes have on the top of the head a peculiar sucking-disk, composed of a series of cartilaginous plates arranged transversely, by means of which they attach themselves to other fishes or to the bottoms of vessels. The common remora attains an average length of 8 inches, and possesses a general resemblance in form to the herring. It is common in the Mediterranean Sea and in the Atlantic Ocean; and also occurs round the British coasts. Species of Echeneis are of larger size. The ancients attributed to the remora the power of arresting and detaining ships in full sail.

Remscheid (rem'shit), a city of Rhenish Prussia. It is the chief seat of the German hardware industry. Pop. (1920), 72,570.

Rémusat (rā-mù-zā), Charles François Marie, Comte de, French philosopher and politician, born at Paris 1797, died 1875. His works include several on English subjects, such as *L'Angleterre au XVIII^e Siècle*, *Bacon*, *Lord Herbert of Cherbury*, and *Histoire de la philosophie en Angleterre depuis Bacon jusqu'à Locke*.

Renaissance. The word Renaissance has two distinct usages—it is used to describe both a period of history and a development of human thought and interest. As a term employed to indicate one of the conventional divisions of the history of Europe, the Renaissance indicates the transition from the Middle Ages to the Reformation, and may be regarded as the beginning of modern history. No single year can be given for the inauguration of so complex a movement as the change from the mediæval to the modern world, but the middle of the fifteenth century is a convenient approximate date. By that time the mediæval theory of the co-operation of the Papacy and the Empire to maintain religion, peace, and order throughout Europe had been abandoned even by idealists, the feudal organization of European society was breaking up, the authority of the individual state was being strengthened by rulers who were laying the foundations of absolute monarchies, and the Ottoman Empire was beginning to menace the safety of European civilization. The capture of Constantinople by the Turks in 1453 has frequently been treated as the beginning of the Renaissance period. A date to mark the close of the period is more difficult to find; the sack of Rome by the Emperor Charles V in 1527 is regarded as defining the close of the Renaissance period in Italy, but different dates must be sought in the history of different countries according as the Reformation affected them late or early. In the interval between the beginning and the end of the Renaissance period of history, the world saw the invention of printing, the use of

the mariner's compass, the development of the employment of gunpowder, the discovery of a new continent, and the initiation of the Copernican system of astronomy. While men's notions of the physical configuration both of the globe and of the universe were thus undergoing a profound change, and the conditions of their daily life were being altered, the political state of Europe was deeply modified. The union of Castile and Aragon brought Spain into the position of a great European power, and Spanish colonies in the New World were making it the world power of the age. France, having expelled the English and consolidated the central power, had entered upon its career of aggrandizement. Italy which brought it into vehement conflict with Spain and made the Italian peninsula the battlefield of Europe. The strong Tudor monarchy was laying the foundations of the future greatness of England, and Scotland was, for the first time, achieving a modest importance in European politics. The Empire was losing its hold on Northern Germany, and, under the Habsburgs, was becoming distinctively Austrian and closely associated with Spain. The Turkish power was rapidly growing in the Mediterranean.

In the sense of an intellectual and literary development, the Renaissance was deeply affected by the course of political events, but it was essentially a development and not a revolutionary cataclysm. The leaders of the Renaissance thought were so deeply immersed in the struggle with the conservative intellectual forces of the time that they naturally exaggerated the significance of their own revolt. They ridiculed the Old Learning and the traditional intellectual methods, and they destroyed many of the manuscripts which had been the accepted and revered textbooks of their predecessors. The name of the great schoolman John Duns Scotus (about 1265–1308), who, as 'Doctor Subtilis', had been a supreme authority for a century and a half, was degraded, within the lifetime of one generation, to give the English language the word 'dunce'. The old subjects of study were regarded as mere stupidity, and were held to represent the abrogation of the powers of the human intellect. This belief in a great and sudden revolt against a system which for centuries had kept the human intellect in chains has been until recent times the generally accepted interpretation of the Renaissance movement. It is now recognized, however, that the leaders of the fifteenth-century Renaissance were the inheritors of a tradition of revolt which can be traced back to the time of Charlemagne and is a marked feature of the life of the twelfth century, when it was closely connected with the rise of European universities. From that time

there has been a continuous intellectual movement, and the names of Abelard, Roger Bacon, the Emperor Frederick II, Dante, Petrarch, and Boccaccio are all those of leaders of new thought and new forms of expression, while the fundamental controversies which divided the schoolmen themselves prevented scholastic philosophy from becoming a cast-iron system. Petrarch (1304-74), although an orthodox mediæval thinker, was emphatically what the men of the Renaissance meant by a 'humanist'—he believed, above everything else, in the dignity of the human intellect and in the necessity, for a well-ordered human life, of bringing the intellectual and volitional powers to bear upon the whole heritage of the past, secular as well as sacred, and he introduced the new study of the Greek and Roman classics which was afterwards the distinctive feature of Renaissance learning. He supplied the impetus which made Italy, at the beginning of the fifteenth century, a great school of classical scholarship. From Italy came the Revival of Learning which, reinforced by the contemporary changes brought about by exploration, invention, and physical speculation, created the difference between the Renaissance and the mediæval world.

In Italy humanism revolutionized the forms of literature, the subjects of intellectual studies, the fine arts, the system of education, and even social manners and customs, but it developed in a direction very different from that contemplated by Petrarch. The Italian humanists of the Renaissance period were sceptics with regard both to religion and morality. Their outlook was frankly pagan, and even high ecclesiastical dignitaries made no pretence of belief in the doctrines, religious or moral, which they officially professed to hold. A deep and widespread refinement, polished learning, and a marvellous power of artistic creation was accompanied by an uncontroverted sway of lust and passion over human action and a degeneration alike in the conduct of individual life and in the relations of the separate states in the Italian peninsula. The invasions of foreign conquerors were part of the penalty paid by the Italians for their rejection of both personal and political morality. Yet Europe owed to Italy a fresh conception of the aims and objects of human life, a new orientation of intellectual interest, a refinement in manners, and a reformed system of education. The work of the Renaissance humanists was the crown and fulfilment of earlier efforts to widen the scope of human thought, and, in particular, to divert investigation and discussion from the old controversies of theology and philosophy to literature and art. Humanism was the study of the achievements of the human intellect without regard to the teachings of a philosophy

which claimed to be based upon a divine inspiration.

From Italy the Renaissance movement spread to the German universities and to some of the courts of the German princes, and it was specially encouraged by the Emperor Maximilian I (1459-1519), who was himself a student of languages, literature, art, and music, and the author of some books. But the purely literary and non-moral side of the movement did not appeal to the practical thought of Germany, and its greatest influence resulted from a humanistic study of the Bible, illustrated by the career of Melancthon (1497-1560), who lectured at the same time upon Homer and on St. Paul's *Epistle to Titus*, "seeking Tyrian brass and gems for the adornment of God's Temple". The German Renaissance thus led directly to the German Reformation. In France the influence of the Italian Renaissance was slightly earlier than in Germany, and dates from the Italian campaign of Charles VIII in 1494, after which French thought and French society were, for many years, in constant contact with those of Italy, and the 'Italianate' Frenchman of the upper classes became a recognized social type. French literature, as represented by De Comines, Rabelais, and, at a later date, Ronsard, French architecture, and French painting were all deeply affected by Italian influences, and France played a great part in the development of classical scholarship and criticism. The scholarship of the French Renaissance came to be associated with the rise of French Huguenotism, because the ecclesiastical authorities, especially in the University of Paris, were the unrelenting enemies of humanism and the New Learning. Calvin was a student at Paris in 1531 and again in 1533, when the supporters of the New Learning were beginning to establish themselves in the university, and his first publication was a commentary on the *De Clementia* of Seneca. The campaigns of Charles VIII brought not only France but also Spain into Italy, and thus introduced the Renaissance influence into Spain, and into Portugal. Renaissance thought and manners never obtained a hold in Spain of the same nature or to the same extent as in France, and, although the work of Cervantes in Spain and of Camoens in Portugal was affected by Italian models, it remained national in spirit. Spain did not share in the linguistic and scholarly revival which marked the Italian and the French Renaissance, and the part taken by the nation in the exploration and exploitation of the New World diverted its interests from the literary side of humanism. In the Low Countries, which were politically associated with Spain during the period, scholarship, on the other hand, was the most distinctive and fruitful product of the Renaissance, apart

from the notable developments of architecture and painting. The great name of Desiderius Erasmus suggests what is to most readers the type and flower of northern humanism, and the work of the Flemish printers did much to extend the humanistic studies.

The Renaissance was late in affecting England, which, in the middle of the fifteenth century, was immersed in the Wars of the Roses. But Englishmen had played a considerable part in earlier intellectual developments, and the Wycliffite movement of the end of the fourteenth century gave a stimulus to theological thought in Europe. The early Italian Renaissance was welcomed by Humphrey, Duke of Gloucester (1391-1447), the youngest son of Henry IV and the founder of the University Library at Oxford, and by John Tiptoft, Earl of Worcester (beheaded 1470). Worcester was one of a small band of English students who went to Italy to imbibe the New Learning, and he translated Cicero's *De Amicitia*. The new ideas gradually made progress; about the year of Worcester's death the study of Greek was introduced into Oxford, and humanistic learning became fashionable under the influence of William Grocyn (1446?-1519); John Colet, Dean of St. Paul's (1487?-1519); Thomas Linacre, the founder of the College of Physicians (1460?-1524); Sir Thomas More; and Bishop Fisher. These men were friends of Erasmus, who lectured both at Oxford and Cambridge, and paid enthusiastic tributes to the English scholars. "When I listen to my friend Colet," he said, "I seem to be listening to Plato himself," and he praised the scholarship of Grocyn, and the profound and refined judgment of Linacre. The effect of the new movement can be traced in the foundations in the English universities in the first half of the sixteenth century, when new colleges and professorships encouraged the study of Greek and Latin literature. It had the sympathy both of Henry VIII and of Cardinal Wolsey, and the first part of Henry's reign was the period of its dominance. Later in the reign public interest was diverted to theological controversy by the Reformation, but this development was in keeping with the general tendency of the English Renaissance, the leaders of which were men of deep religious feeling. The book which most deeply influenced the English Renaissance scholars was Erasmus's edition of the Greek text of the New Testament (1516), and its natural result was Tyndale's translation of the New Testament and Coverdale's English Bible. While the Renaissance thus passed into the Reformation in England, the course of events in Scotland was different, for the Reformation preceded the Renaissance. Greek was not introduced until after the reformed faith had made some progress—the date usually assigned is 1534—and the

changes in the studies of the universities followed the fall of the Roman Church in 1560. The most eminent Scottish Renaissance scholar, George Buchanan (1506-1582) was the ally of the Scottish Reformers in the days of their power, and his successor, Andrew Melville (1545-1622), was primarily a Protestant ecclesiastic and distrusted purely literary studies.—BIBLIOGRAPHY: J. A. Symonds, *The Renaissance in Italy*; H. Hallam, *Literature of Europe in the 15th, 16th, and 17th Centuries*; Sir J. E. Sandys, *Short History of Classical Scholarship*; *Cambridge Modern History* (vol. i), *The Renaissance* (chapters xvi and xvii).

Renaissance Architecture, a style which originated in Italy in the first half of the fifteenth century, and afterwards spread over Europe. Its main characteristic is a return to the classical forms and modes of ornamentation which had been displaced by the Byzantine, the Romanesque, and the Gothic. From Florence the style was introduced into Rome, where the noble and simple works of Bramante (died 1514) are among the finest examples of it, the chief of these being the palace of the Chancery, the foundations of St. Peter's, part of the Vatican, and the small church of San Pietro in Montorio. It reached its highest pitch of grandeur in the dome of St. Peter's, the work of Michelangelo (q.v.), after whom it declined. Another Renaissance school arose in Venice, where the majority of the buildings of the sixteenth and seventeenth centuries are distinguished by the prominence given to external decoration by means of pillars and pilasters. From this school sprang Palladio (1518-80), after whom the distinctive style of architecture which he followed received the name of Palladian. The Renaissance architecture was introduced into France by Lombardic and Florentine architects about the end of the sixteenth century, and flourished there during the greater part of the following century, but especially in the first half under Louis XII and Francis I. The early French architects of this period, while adopting the ancient classical orders and other features of the new style, still retained many of the features of the architecture of the preceding ages; later on they followed classical types more closely, as in the palace of the Louvre. Into England the Renaissance style was introduced during the time of Elizabeth, and it is there represented by the works of Inigo Jones (1572-1652), Sir C. Wren (1632-1723), and their contemporaries, St. Paul's, London, being the best-known example of the latter architect.—BIBLIOGRAPHY: W. J. Anderson, *Architecture of the Renaissance in Italy*; Sir R. Blomfield, *History of Renaissance Architecture in England*; J. A. Gotch, *Architecture of the Renaissance in England*.

Renaix (rè-nâ; Fl., *Ronse*), a town and railway junction of Belgium, in the province of East Flanders. It has manufactures of cotton, woollen, and linen goods, and tobacco. Pop. 22,000.

Renan (rè-nân), Joseph Ernest, French philologist and philosopher, born at Tréguier, in Brittany, 27th Feb., 1823, died in Paris 2nd Oct., 1892. He studied at the seminary of St. Sulpice, Paris, but in 1845 gave up all intention of becoming a priest, and devoted himself to historical and linguistic studies, especially the study of Oriental languages. In 1848 he obtained the Volney prize for an *Essay on the Semitic Languages*. In 1849 he was sent by the Academy of Inscriptions and Belles-Lettres on a mission to Italy, and in 1860 on a mission to Syria. In 1862 he was appointed professor of Hebrew in the Collège de France, but an outcry against him, owing to his sceptical views, caused him to be suspended immediately. He was reappointed to the chair in 1871. Meantime, in 1863, he published his brilliantly sceptical *Vie de Jésus* (called by Oscar Wilde "the Gospel according to St. Thomas"), which gained him a European reputation. This book was the first part of a comprehensive work, the *Histoire des origines du christianisme*, which includes *Les Apôtres* (1866), *St. Paul* (1869), *L'Antéchrist* (1871), *Les Évangiles* (1877), *L'Église chrétienne* (1879), and *Marc-Aurèle* (1882), all written from the sceptical standpoint.—Cf. H. Desportes and Bournand, *Ernest Renan: sa vie et son œuvre*.

Renard, or **Reynard**, the Fox, the name of the greatest mediæval beast epic, in which the characters are animals, the fox being the hero. In Latin it first appeared in a poem of considerable length belonging to about 1150; the oldest known German version is that of a minnesinger, Heinrich der Glicheære, belonging to a period not much later. An excellent Dutch version of the fable appeared in Flanders about 1250, under the title *Reinaert de Vos*, and this subsequently received modifications and enlargements. In 1498 a version in Low German, probably by Herman Barkhusen, a printer of Rostock, appeared. It was evidently taken from the prose version in Dutch, of which Caxton published an English translation. On this Low German version was founded Goethe's rendering (1794) into modern German hexameters. In France the history of Renard was enormously popular, and from the end of the twelfth to the middle of the fourteenth centuries many forms of it appeared. There have been several English forms of the fable, as well as Danish, Swedish, &c.—BIBLIOGRAPHY: F. S. Ellis, *History of Reynard the Fox*; Joseph Jacobs, *Reynard the Fox*.

Rendsburg, a town of Prussia, in the province of Schleswig-Holstein. It is advantageously situated for trade, being connected with the North Sea by the Eider, and being also on the line of the Kiel Canal. Pop. 17,000.

René (rè-nâ'), or **Rena'tus I of Anjou**, titular King of Naples, second son of Louis II of Naples, duc d'Anjou, and Yolande daughter of John, King of Aragon, was born at Angers in 1409, died in 1480. In 1420 he married Isabella, daughter of Charles II, Duke of Lorraine, and on the death of his father-in-law in 1431 he laid claim to that dukedom; but Count Antony of Vaudemont, son of the brother of Charles II, contested his right, drove him out of Lorraine, captured him, and held him a prisoner for several years. In 1434 his elder brother, Louis III of Anjou, who had been in actual possession of the throne of Naples and Sicily, died and left to him Provence, Anjou, Naples, Sicily, and Jerusalem. In 1437 René bought his liberty and the acknowledgment of his right to Lorraine for 400,000 florins, and in the following year he led an army to Naples, where his claims were disputed by Alfonso, King of Aragon. René was unsuccessful, and in 1442 returned to Lorraine, the government of which he gave up to his son John, who, after his mother Isabella's death, entered into full possession under the title of John II. On this René retired into Provence, and devoted himself to agriculture, manufactures, literature, and art.

Renfrew, a royal burgh of Renfrewshire, Scotland, on the Clyde; served by the Glasgow & South-Western Railway, and by tramways from Glasgow direct or via Paisley. It is the greatest dredger-building centre, and has the largest water-tube boiler-works in the world. There is a large dock belonging to the Clyde Trust. Pop. (1921), 14,160.

Renfrewshire, an historic county of South-Western Scotland, the twenty-seventh of that kingdom in size, one of the few counties of the west coast that lies entirely within the Lowlands; area, 250 sq. miles; pop. (1921), 298,890. Although it lies mainly south of the Clyde and bordered by it, the northern banks of the river between Whiteinch and Yoker and a small part of the interior, including Jordanhill, belong to the county. This small detached portion formed part of the barony of Renfrew, at one time settled on Waiter Fitzalan by the king; but before the deepening of the Clyde it also constituted the northward side of a fordable part of the river, and it is these two facts that account for its isolated position.

Physiography.—In the north-east the county is fiat; an elevated moorland area extends from the Firth of Clyde across to the south-eastern extremity, and is divided into three

distinct masses by two large rift valleys,¹ which have a general trend from south-west to north-east. These high moorlands are generally flat-topped and contain many lakes (Thom, Goin, Binend, Gryfe, &c.), now impressed as reservoirs to augment the water-supply of the large local industrial communities. Occasionally, however, there are distinct peaks, as in the Hill of Stake (1711 feet altitude), East Girt Hill (1673 feet), and Misty Law (1663 feet). Rivers include the White Cart, Black Cart, and the Gryfe.

¹ These are typical of the Great Rift Valley (Palestine-Nyasaland; see *Red Sea*). By a fracture of the earth's crust along two parallel lines the enclosed portion in each case has subsided, forming a wide, flat, steep-sided valley. In the case of Renfrewshire these valleys are of the utmost importance for communication with the southern counties and with England. The first gap runs via Castle Semple Loch, and carries the Stranraer line of the Glasgow & South-Western Railway. The second one extends from Barrhead to Caldwell and Uplawmoor, and carries the G. & S. W. main line for Kilmarnock, Dumfries, and London. Along the north-eastern flats, along the narrow alluvial flat of the coast, and through Strathgryffe run other communicating lines to Greenock, Gourrock, and Wemyss Bay.

Productions.—The principal industries are thread-making and shipbuilding (including repairs). Dredgers are constructed at Renfrew. Engineering is fairly general, and there is an Admiralty torpedo-factory at Greenock. Sugar is also refined at that port. Cereals and root crops are raised. Coal, limestone, shale, ironstone, &c., are found.

Towns.—The chief are: Barrhead (pop. 1921, 11,400), Gourrock (10,130), Greenock (81,120), Johnstone (12,470), Paisley (84,840), Port Glasgow (21,000), and Renfrew (14,140), all burghs.

See *Scotland; Paisley; Renfrew; Port Glasgow*.—Cf. F. Mort, *Renfrewshire* (Cambridge County Geographies).

Rennes (renn), a city of France, formerly capital of Brittany, now capital of the department of Ille-et-Vilaine, situated at the confluence of the Rivers Ille and Vilaine. It is traversed from east to west by the Vilaine, which divides it into the High and the Low Town. The most notable buildings are: the cathedral (1787–1844), the Palais de Justice, the Hôtel de Ville, the university (founded 1735), a national agricultural college, the lycée, and the theatre. The industries include tanning, bleaching, shipbuilding, and sail-making. Rennes is the seat of an archbishop, the head-quarters of a *corps d'armée*, and has a large arsenal and barracks. Pop. (1921), 82,240.

Rennet, a liquid extract used in cheese-making for coagulating the milk. It contains as its active principle an enzyme called *rennin*, and another ferment, *pepsin*. Additional to these are salt, organic matter, and some preservative, usually boric acid.

Rennet is prepared from the 'vells', or fourth stomach, of a sucking calf. It is a catalyst. It

acts only in a neutral or an acid medium, and its properties are destroyed by alkali, e.g. gargetty milk is alkaline, and upon it rennet has no obvious effect. The optimum temperature, or temperature at which the ferment is most active, is about 106° F., but a temperature of 84° or 85° F. is usually maintained as a renneting temperature in cheese-making. Pasteurized milk does not give a normal curd until the lime-content of the milk is readjusted. It is necessary to have the lime salts in a soluble condition in the milk, and calcium chloride or calcium phosphate when added restores the rennet action.

Rennie, John, British civil engineer, son of a farmer, was born at Phantassie, East Lothian, in 1761, died in London in 1821. He was employed by Messrs. Boulton & Watt, and went to London, where his reputation rapidly increased, until he was regarded as standing at the head of the civil engineers of Great Britain. Numerous bridges, canals, docks, and harbours bear testimony to his skill: among others, Southwark Bridge, Waterloo Bridge, and London Bridge across the Thames; the Crinan Canal, the Lancaster Canal, and the Avon and Kennet Canal; the London Docks, the East and West India Docks, and docks at Hull, Greenock, Leith, Liverpool, and Dublin; the harbours at Queensferry, Berwick, Howth, Holyhead, Kingstown, and Newhaven; and the Government dockyards at Portsmouth, Chatham, Sheerness, and Plymouth.

Reno, the largest city of Nevada, United States, the county seat of Washoe county, on Truckee River; served by the Nevada-California-Oregon, Southern Pacific, and the Virginia and Truckee Railroads. The city contains the University of Nevada, and a federal agricultural test and experimental station. The workshops of the Nevada-California-Oregon Railroad are within the city, which manufactures also lumber goods, plaster, canned meats, flour, and foundry products. Reno was founded in 1868, and became a city in 1879. Pop. 12,020.

Renoir, Pierre Auguste, French painter, born at Limoges 1841, died 1919. The early 'eighties saw the production of many of his masterpieces, including the *Moulin de la Galette*, *The Terrace*, and *Madame Charpentier and Family* (now in the Metropolitan Museum, New York). In the 'nineties his increased use of carnations emphasized his kinship to Rubens; and his later work, represented by a superb series of *Bathers* and many portraits, is marked by its glowing colour and increased emphasis on form. Neglected for a long period, Renoir eventually became one of the leading painters in Europe. He is adequately represented in the Louvre and the Luxembourg; and there is one good example (*The Umbrellas*) in the Tate Gallery.

Rent is the term applied to the annual payment made to the owner by the tenant of land, houses, and other buildings. The actual sums paid in rent will usually cover a normal return upon the capital invested by the owner in buildings and improvements on the land, together with a certain payment for the use of the land itself. This latter payment is called by economists the 'net rent' or 'pure rent' of land, and it has been the subject of much controversy and a great deal of rather subtle analysis since the days of Adam Smith and Ricardo.

Land differs from the other two chief agents of production, labour and capital, in two respects of great importance from an economic standpoint. The supply of land is, broadly speaking, fixed and unalterable; and its utility to human beings varies according to its situation and fertility in an almost infinite gradation from the gigantic value of sites in the centre of a great city to the worthlessness of the desert. There are thus two aspects from which the value and rent of land may be regarded: the scarcity aspect and the differential aspect. The fact that the supply of land is fixed is important because it involves another fact, that the price and rent of land must depend entirely on the demand for it. If the demand for any commodity 'increases, the price will rise until an increased supply is called forth; but if the demand for land increases, the price (and the rent) may rise indefinitely, because no increased supply will be forthcoming. Similarly, if the demand for land falls off, there is nothing to check the consequent fall in price and rent. For this reason it is sometimes proposed that a special tax should be put upon the 'unearned increment' in the value of land which is due to the growth of population and the progress of society.

The differential aspect of land accounts for the wide variation to be found in 'pure rents', after due allowance has been made for the return on invested capital which forms part of the 'gross rent' charged by the landlord to the tenant. Even in a highly populated country like England there are large tracts of land so remote from the towns as to be of no value for building factories, and so unfertile as to be not worth cultivating. Somewhere between these waste places and the rich and fertile fields of Norfolk will be found some land which it is just worth while to cultivate; an average farmer will just be able to make a living here, on 'the margin of cultivation'. For such land as this no 'pure' or 'economic' rent is paid at all. Some payment will no doubt be made in nearly every case to the landlord, but if the land is truly 'marginal', the rent will consist entirely of interest on the capital invested by the landlord in buildings, &c. A piece of land for which it is worth while

to pay rent will not be truly on the margin of cultivation, because there must be other pieces slightly inferior to it which it will just pay to cultivate at no rent at all.

It follows from the foregoing analysis that the pure economic rent of any given piece of land represents the value which it derives from its situation or fertility in excess of land on the margin of cultivation. Under conditions of free competition a landlord is able if he wishes to exact a rent which, in addition to yielding the current rate on interest on capital invested in buildings, represents this differential advantage. In practice, of course, this will only be very roughly and approximately attained.

The chief service which rent performs for the community as a whole is that it enables land to be apportioned between various uses in such a way that the maximum utility tends to be achieved. This function of rent is so important that it could not be dispensed with even if the individual landlords were dispossessed and the land was taken into common ownership by the community under some form of land-nationalization.

Various diverse systems of land tenure obtain in different countries, the respective merits of which constitute a most important problem for statesmen. These systems, however, can only be judged by reference to the principles governing the rent of land in its purest form, which have been outlined in this article.

Renton, a town of Scotland, in Dumbartonshire, 3 miles north of Dumbarton, on the Leven; served by the Dumbarton & Balloch joint line (North British and Caledonian Railways). Calico-printing, bleaching, and dyeing (turkey red) are the principal industries. In the town is a monument to Tobias Smollett, who was born in the neighbourhood. Pop. 5000.

Rep, or **Repp**, any kind of fabric in which prominent ribs, lengthwise or crosswise, are formed (see *Poplin* for warp ribs or *repps*). Weft ribs or weft *repps* have a much greater number of weft picks than warp threads, and in these fabrics only weft is shown; certain coloured skirts for women are made with this structure. The name *repp* is really a definition of structure, although worsted dress fabrics are perhaps the most common of warp *repps*.

Repairs, in law, is the term denoting the repairs done to a house or tenement by the landlord or tenant during the currency of a lease. In England, unless there is an express agreement, neither the landlord nor the tenant is, as a rule, liable to execute repairs. By statute, however, it is provided that, in the case of working-class houses, any such house is impliedly warranted by the landlord as in all respects reasonably fit for human habitation

at the commencement of the tenancy, and there is an implied obligation on the landlord to keep it in such condition during the tenancy. In other cases, it is usually stated in the lease which party is to do the repairs. In Scotland the landlord is bound at common law, independently of stipulation, to make all necessary repairs; and if he fails to do so, the tenant may make them himself and deduct the amount from his rent, or sue for damages. See *Landlord and Tenant*.

Reporting, Parliamentary. The press galleries of the House of Lords and of the Commons, particularly the latter with its writing- and recreation-rooms, are now recognized as an important and essential section of the British legislature. The staff which compiles the official parliamentary debates, issued daily, works in the press gallery of the Commons; in the Lords, the official reporters sit on the floor of the chamber near the clerks. Altogether over two hundred journalists work in the press gallery; the reporters, who include the most skilled shorthand writers, are responsible for the reporting of the speeches, while the sketch writers, the lobby correspondents, and others are the trained political journalists who expound and criticize. The present position was not attained without a prolonged and bitter struggle. Until late in the nineteenth century the reporting of the proceedings was a gross breach of privilege, and from the rise of the printed newspaper, early in the eighteenth century, when Abel Boyer, a Frenchman, commenced a magazine entitled *The Political State of Great Britain*, a veritable war was waged to break down the barriers. It lasted throughout the eighteenth century, rising in 1771 to a fierce contest between Parliament and the City of London, which took up the cause of persecuted printers. The people joined in on the side of the Lord Mayor, Brass Crosby, M.P., who was sent to Newgate jail; there was rioting outside Parliament, the Lord Mayor became a hero, and effigies of the Speaker and others were burned on Tower Hill. Only after this episode, in which Burke took a prominent part on the side of liberty in the House, did Parliament reluctantly recede from an attitude in which it was rendered ridiculous. Before this, editors and printers had been dragged to the bar of the Commons, to be reprimanded on their knees by the Speaker, or to be committed to prison. They had resorted (in the *London Magazine*) to the subterfuge of reporting Parliament as a political club, with Roman names, or (in the *Gentleman's Magazine*) as *Debates in the Senate of Magna Lilliputia*, and subsequently providing a key to the names. The reports were obtained in the lobby or in the adjoining coffee-houses, Samuel Johnson

was one of the reporters, although he was in the strangers' gallery once only; he made up the speeches from brief notes, and the famous reply of Pitt to Walpole, regarded to this day as one of the gems of English oratory, was his composition. Later, Coleridge, Hazlitt, and Charles Dickens were reporters, the last mentioned being engaged when the press gallery was officially provided and opened in 1831. Before this, however, pressmen were allowed on sufferance to sit in the back row of the strangers' gallery in the Commons, or stand at the bar in the Lords, and were not supposed to take notes. In those days the most famous reporter was William ('Memory') Woodfall, who sat with eyes closed for hours in the gallery and subsequently wrote out the speeches. The right to take notes was recognized in 1803, but for doing so in the front row a reporter was brought to the bar. The Lords provided a press gallery (facing the Throne) in 1831, and the Commons (above the Speaker) in the new building after the fire in 1834, but an aggrieved member could have the pressmen excluded by simply saying, "I spy strangers", and up to 1875 reporting was technically illegal. The present official report dates only from 1909; it took over *Hansard*, the report so-named from the original printer, which had been started in 1800 by William Cobbett and had for some years been subsidized by the Government. Parliament still retains the power to exclude the press on occasion, and this was done once or twice during the European War. Several parliamentary journalists have subsequently become members of Parliament and have gained distinction. Among them are: Lord Russell and Lord Hewart, who each became Attorney-General and then Lord Chief Justice; Sir Henry Duke, who was in the Cabinet and then became President of the Divorce Court; and Sir Edward Clarke, K.C.—Cf. Michael Macdonagh, *The Reporters' Gallery*.

Reports, in regard to courts of law, statements containing a history of the several cases, with a summary of the proceedings, the arguments on both sides, and the reason the court gave for its judgment. In England reports of law cases are extant from the reign of Edward II. Up to the time of Henry VIII the reports were taken officially at the expense of the Government, and published annually under the name of *Year-books*; but afterwards, until 1865, the reports were made by private individuals in the various courts. In 1865 an improved system of law reporting was instituted by the English Bar under the superintendence of the Council of Law Reporting, who publish what are called the 'authorized reports'. They have no monopoly, however, for several legal journals pub-

lish contemporaneous reports. The reports of cases in the Scottish courts are furnished by periodical legal journals and private professional publications.

Repoussé (rè-pô'sā), a kind of ornamental metal-work in relief. It resembles embossed work, but is produced by beating the metal up from the back, which is done with a punch and hammer, the metal being placed upon a wax block. By this means a rude resemblance to the figure to be produced is formed, and it is afterwards worked up by pressing and chasing the front surface. The finest specimens of this style are those of Benvenuto Cellini of the sixteenth century.

Representation of the People Act. The latest and perhaps the most important of the Reform Acts (q.v.) passed since 1832 is the Representation of the People Act, 1918, subsequently amended on minor points. That Act gave women the franchise, and increased the parliamentary electorate by some 8,000,000 to over 21,500,000. All men over twenty-one years of age who have had six months' residence or occupation of business premises, and all women over thirty years who are local government electors or the wives of such electors, are entitled to vote. All polls must now take place on one day, and no elector can vote in more than two constituencies. In Great Britain there is one member to (as nearly as possible) every 36,000 of the electorate. See *Registration of Electors*.—Cf. Sir Hugh Fraser, *The Representation of the People Acts, 1918 to 1921*.

Representative Government. The development of representative government belongs distinctively to mediæval and modern history. In the Ancient World democracies were small and did not require representative institutions; at Athens the supreme governing assembly included all men, over a certain age, who possessed the rights of full citizenship, and there were similar governing assemblies in other Greek democracies. Hence, the ideal states described by Aristotle and Plato were single cities in which full citizenship could be acquired only by a limited class of leisured men, tradesmen and retail merchants being excluded. Such a state existed only in imagination, but it must be remembered that the actual Greek states were based on slavery, and that the number of male citizens who, in a democracy, sat in the assembly was small in proportion to the total population. In the later stages of Greek history the principle of representation was introduced, in practice if not in theory, by the revival of the Achaean League of federated cities (281 B.C.). The League had a central assembly which controlled foreign policy, and though any full citizen of any city had a right to speak in this assembly, citizens who came

from any city other than that in which the assembly met must necessarily have enjoyed what were, in effect, representative powers. In Rome, under the Republic, there were two assemblies, the *Comitia Centuriata*, composed of all citizens liable to military service, and the *Concilium Plebis*; the former elected the consuls, praetors, and censors, and the latter the tribunes of the people. The executive was thus composed of elected magistrates, and in this sense the government was representative, though there was no representative assembly. Under the Empire it was a maxim of the lawyers, at all events from the second century A.D., that the unlimited personal authority of the emperor depended upon the consent of the people, but it was assumed that their consent had been given once for all and could not be recalled, and there was no representative or other democratic assembly capable of asserting the right of the people.

Representative government in the modern sense may be said to be an incidental outcome of the feudal system, or rather of the existence of that system in a nation state. Feudal theory provided for an assembly of landowners, who had the duty of advising the monarch and, at the same time, the opportunity of preventing any royal interference with their own rights. Such great councils possessed judicial powers and gradually secured legislative authority, but they were unwilling to deal with questions of taxation. The king was supposed to be able 'to live of his own', i.e. the royal estates, the profits of the royal courts of justice, and the recognized feudal dues and 'aids' were held to suffice for the maintenance of government. As national policy, and especially foreign and military policy, advanced, this theory became impracticable, and the sovereign had to find some means of obtaining money by special taxation. Meanwhile the towns had been rising to importance and wealth, and it was right that they should share in the burden of taxation. They already made an annual payment to the royal exchequer, but such payments were defined by the terms of their charters and could not be increased. It was therefore in the royal interest that burgesses should be admitted to the national councils, and the feudal magnates could not resent the presence of members who were summoned in order to bear a proportion of the taxes about to be levied. This consideration explains the inclusion of burgess members, necessarily representatives, into the national councils of England, France, and Scotland in the thirteenth and fourteenth centuries.

In Scotland and in France the representative element in the national assemblies was for long confined to the towns. All landowners who held their land directly from the Crown were, in

theory, entitled to attend; it was not until the end of the fifteenth century that elected deputies were sent to the States-General from the country districts of France, and another hundred years elapsed before the smaller tenants-in-chief in Scotland, who had long ceased to attend Parliament in person, began to elect representatives. The history of England is of supreme importance in the development of representative government, for, in the course of the thirteenth century, not only towns but counties elected members to represent them in Parliament, and the county electors were not necessarily tenants-in-chief of the Crown. The rapid (though not continuous) growth of the influence of the English Commons produced at times what might be called 'representative government' in England as early as the fourteenth century, but this statement requires considerable limitations. In the first place, the Commons (the term House of Commons is of later date) did not represent all classes of the population; the towns invited to send burgesses to Parliament were for long selected by the Crown, and the electors in the counties were, or came to be, the upper middle-classes. Further, the conception of 'representation' in the modern sense is of later date. The earliest use of the word 'represent' and its derivatives in connection with the English Parliament dates from the seventeenth century, although the general sense of acting as an accredited deputy for a single person is found a hundred years earlier. The word occurs as early as 1441 in Scotland, where the elected commissioners of the towns were described (in Latin) as constituting and representing the Third Estate; in 1472 the 'lords of haly kirk' were described (in English) as "representing the estate of the clergy". But this usage is probably connected with the older sense of the word as 'bringing into presence'. The burgess commissioners brought into presence the whole estate of burgesses, and so fulfilled an obligation resting upon the burghs. The transition to a conception of trusteeship of the interests of constituents is not found, in theory, until the seventeenth century, although, in practice, representatives must often have performed this function.

A great impulse was given to the theory of representative government by the controversies during the Cromwellian period. It was already acknowledged that the two English Houses of Parliament were 'the representative body of the kingdom', but the demands of the Levellers for the extension of the franchise, so that the representative body might be elected by the whole male population of England, called attention to a wider theory of representative government, and the actual franchise on which the Cromwellian Parliaments were elected gave a

vote to new classes of the community. The old Constitution, under which the House of Commons represented only the rich merchants in a limited number of towns and the county gentlemen and yeoman farmers in the counties, was restored with Charles II, and the circumstance that the Parliament so elected brought the country safely through the crisis of the Revolution gave the old system a new lease of life. In the beginning of the reign of George III discussions as to the proper character of representative government again attracted public attention, and the controversies which preceded the American War of Independence brought the subject into prominence. Representative assemblies had long existed in the colonies, and the nature of representative government was better understood there than in the home country. The demand 'no taxation without representation' did not then express, and never has expressed, a principle of British constitutional law, but the remark of so warm an admirer of the existing Constitution as Edmund Burke, that "we ought not to be quite so ready with our taxes until we can secure the desired representation in Parliament", admitted the propriety of a connection between the two. The American victory, and the establishment of the Constitution of the United States, gave a fresh impetus to the theory of representative government, and there soon followed fresh impulses from revolutionary France. The European tendency to the creation of new Constitutions in the end of the eighteenth century and the beginning of the nineteenth was based upon a belief that the representation of all, or of certain, classes of the male population formed the only possible basis of a secure and permanent government. In Great Britain the alarm created by the excesses of the French Revolution delayed the victory of those who advocated the broadening of the old system of representation, and even in 1832 they had to be content with a very moderate change. Successive Franchise Acts have made a vast extension in the proportion of the population which is represented in Parliament, and in many other countries the triumph of representative government has been a feature of the history of the last hundred years. It has, however, to be admitted that not every nation is capable of fulfilling the responsibilities inherent in the representative system, and it must be remembered that representative government possesses no 'divine right' any more than absolute monarchy. Representative government can be successful only if it is suited to the needs of the people and the times, and in advanced communities this depends upon the exercise of the franchise with a full sense of its responsi-

bilities. The danger to representative government lies chiefly in the devices which are necessary to give effect to it. In theory representation does not necessarily imply election, and it is conceivable that, under the existing British Constitution, the House of Lords might at times be more truly representative of the national wishes than the House of Commons. Election is the conferment of a formal certificate of the existence of a representative status, and if the electors were always or usually unanimous in making a free and deliberate choice, no problem would arise. The difficulty which actually exists is to reconcile the principles of representative government with the conferment of the representative status upon a candidate elected by a trifling majority, or, still more, upon a candidate who, though at the head of the poll, has received a minority of the votes cast by the electors. The advocates of 'proportional representation' are concerned with the correction of this defect in the existing machinery for securing the existence of representative government. In recent years representative government, as a principle, has itself been attacked by extreme politicians, who would substitute for it the government of a single class of the community, acting through autocratic leaders—the system which has brought Russia to ruin.—BIBLIOGRAPHY: J. S. Mill, *Representative Government*; H. Spencer, *Representative Government (Essays, vols. ii and iii)*; J. Lubbock (Lord Avebury), *Representation*; G. Wallas, *Human Nature in Politics*.

Reprisals, retaliation for a wrong committed. "Reprisals", says Hall, "are resorted to when a specific wrong has been committed, and they consist in the seizure and confiscation of property belonging to the offending State or its subjects by way of compensation in value for the wrong; or in seizure of property or acts of violence directed against individuals, with the object of compelling the State to grant redress", or, it may be added, for the purpose of revenge. Reprisals may take many forms, e.g. the burning or bombing of houses, the treatment of prisoners of war contrary to humanity or the rules of international law, the imposition of a levy, the shooting or exposure to danger of non-combatants, &c. The efficacy and morality of reprisals are subjects of dispute.

Reproduction, the process by which animals perpetuate their own species or race. Reproduction may take place in either or both of two chief modes. The first of these may be termed *sexual*, since in this form of the process the elements of sex are concerned—male and female cells uniting. The second of the modes may be named *asexual*, since in it no elements of sex are concerned. 'The distinctive character of

sexual reproduction consists in the essential element of the male (*sperm-cell* or *spermatozoon*) fusing with the essential element of the female (*germ-cell*, *ovum*, or *egg*), whereby the latter is fertilized or impregnated, and then develops into an embryo. Whether these elements, male and female, be furnished by one individual or by two—or in other words whether the sexes be situated in separate individuals or not—is a fact of immaterial consequence in the recognition and definition of the sexual form of the process. The reproductive process, therefore, may be (I) *Sexual*, including (A) Hermaphrodite or Monœcious parents possessing male or female organs in the same individual, and these may be (a) self-impregnating (for example, the tapeworm), or (b) mutually impregnating (for example, the snail); and (B) Dicoecious parents, which may be (1) Oviparous (for example, most fishes, birds, &c.), (2) Ovo-viviparous (for example, some amphibians and reptiles), or (3) Viviparous (for example, mammals). Or the reproductive process may be (II) *Asexual*, including the processes of (A) Gemmation or budding (internal, external, continuous, or discontinuous), and (B) Fission (transverse, longitudinal, irregular).

The most perfect form of the reproductive process is best seen in the highest or vertebrate animals, where the male elements are furnished by one form, and the female elements by another. The sperm-cells or spermatozoa reach the ova in various ways. The fertilized ova may undergo development external to the body of the parent, either independently (as in the eggs of fishes), or the parent may (as in most birds) incubate or hatch them. Those forms which thus produce eggs from which the young are afterwards hatched are named *oviparous* animals. In other cases (as in the land salamanders, vipers, &c.) the eggs are retained within the parent's body until such time as the young are hatched, and these forms are hence named *ovo-viviparous*; whilst in most mammalia the young are completely developed within the mother's body, and are born alive. Such animals are hence said to be *viviparous*. In the higher mammals, which exhibit the viviparous mode of reproduction in fullest perfection, the mother and embryo are connected by a structure consisting partly of foetal and partly of maternal tissues, and which is known as the *placenta* (q.v.). In the tape-worms we find familiar examples of normal hermaphrodite forms. Each segment or *proglottis* of the tape-worm contains a complete set of male and female reproductive organs. These organs between them produce perfect or fertilized eggs, each of which under certain favourable conditions is capable of developing into a new tape-worm. The snails

also form good examples of hermaphrodite animals, and illustrate organisms which require to be mutually impregnated in order to produce fertilized eggs—that is to say, the male element of one hermaphrodite organism must be brought in contact with the female element of another hermaphrodite form before the eggs of the latter can be fecundated. See also *Fission*; *Gemmation*; *Generation*; *Ovum*; *Parthenogenesis*, &c. For reproduction in plants, see *Botany*.

Reptiles, or **Reptilia**, a class of vertebrates, constituting with the birds, to which they are most closely allied, Huxley's second division of vertebrates, Sauropsida. Birds and mammals are specialized branches of the reptilian stock. Reptiles differ from amphibians chiefly in breathing through lungs during the whole period of their existence, and in developing without metamorphosis; and from birds in being cold-blooded, in being covered with plates or scales instead of feathers, and in the forelegs (except in the extinct Pterosauria) never being converted into wings.

The class may be divided into eleven subclasses, as follows: (1) Proreptilia. Primitive Permian forms. (2) Prosauria. Permian and Triassic forms, with one recent species, the Tuatera (*Sphenodon* (Hatteria) *punctatum*) of New Zealand. (3) Theromorphia. Permian and Triassic forms, some of which present certain resemblances to mammals. (4) Chelonia. Turtles and tortoises. (5) Dinosauria. Mesozoic forms, some of immense size. (6) Crocodilia. Crocodiles and alligators. (7) Plesiosauria. Mesozoic marine reptiles, with paddle-like limbs and often with greatly elongated necks. (8) Ichthyosauria. Mesozoic marine reptiles, resembling cetaceans in form. (9) Pterosauria. Flying Mesozoic reptiles. (10) Pythonomorpha. Cretaceous marine reptiles of considerable size, with snake-shaped bodies and paddle-like limbs. (11) Sauria. Lizards (ord. Lacertilia) and snakes (ord. Ophidia).

The exoskeleton varies greatly in its development throughout the class. As in the tortoises and turtles and crocodiles it may attain, either separately or in combination with the endoskeleton, a high development. In serpents and many lizards it is moderately developed, while in some lizards the skin is comparatively unprotected. The endoskeleton is always completely developed and ossified. The vertebral column in the quadrupedal forms is divided into four or five regions, less distinctly differentiated, however, than in the mammals. The ribs differ considerably in their mode of attachment to the vertebræ, but are always present, and in a state of greater development than in the amphibians. The body, except in the case of the tortoises, is of an elongated form. The limbs are very differently developed in the different species. In the serpents and some lizards they are completely

wanting or atrophied; in other lizards they are rudimentary; while in the remainder of the class sometimes the anterior and sometimes the posterior limbs are developed, and not the others. In recent types the limbs are not developed to the same extent as in birds and mammals, these members seldom being of sufficient length to keep the body from the ground. In some of the forms, living or extinct, the limbs are modified for swimming or for flight. The lower jaw is connected with the skull through the intervention of a quadrate bone, and, as this often projects backwards, the opening of the mouth is very great, and may even extend beyond the base of the skull. Teeth, except in the turtles and tortoises, are present, but are adapted rather for seizing and holding prey than masticating food, and, except in the crocodiles, are not sunk in sockets. The skull possesses a single occipital condyle, by means of which it articulates with the backbone. The brain is small compared with the size of the skull. The muscular system is developed more like that of the birds and mammals than that of the amphibians or fishes. The intestinal tract is generally differentiated into an œsophagus, stomach, small intestine, and large intestine. It terminates in a cloaca, which is also common to the efferent ducts of the urinary and generative systems. In some forms (as snakes) the stomach, like the gullet, is capable of great distention. The heart has only three cavities, viz. two separate auricles and a single ventricular cavity, usually partly divided into two by an incomplete partition. Respiration is always performed by the lungs, which are highly organized, and often attain a great size. The ova are in general retained within the body of the parent until the development of the young has proceeded to a greater or less extent, and then expelled and left to the heat of the sun; but in some forms (certain snakes and lizards) they are hatched in the interior of the body. Reptiles are found in greatest number, and in most typical form and variety, in the warm or tropical regions of the earth. During winter, or in the colder seasons of the year, most reptiles hibernate, and snakes are notable as periodically moulting their skin or epidermis. See separate articles under various headings.

Republic, a form of government which, though opposite to that where power is concentrated in the hands of a single person or a ruling group, is by no means invariably one in which the whole of the inhabitants of a country take part either directly or by representatives. The republics of ancient Greece and Rome were, even in their most advanced form, little more than oligarchic in character, and the average citizen of either country would have received with astonishment the suggestion that slave-holding was out of

place in a nominal republic. Experience at this time, and for long after, went to show that, while oligarchies were more or less stable, democracies were almost always very liable to sudden overthrow. Democratic Athens collapsed; while aristocratic Venice saw her sister cities, Genoa and Florence, subject to a ceaseless state of change, and even modern republics have sometimes passed into the condition of a limited monarchy, as did the Netherlands.

With regard to different types of republics, France and Portugal belong to that called *unitary*, the population being in either case homogeneous; the *federal* type is seen in Switzerland, Brazil, and the United States, where is displayed the federation of a group of independent states. The countries of both North and South America are, with the exception of Canada in the north, and of the West Indies with the British, French, and Dutch Guianas in the south, entirely republican. Of curiosities in republics may be mentioned the small and secluded Pyrenean republic of Andorra in North-Eastern Spain, and that of San Marino in Italy; the government of the free cities, Fiume, Hamburg, Bremen, and Lubeck, is republican in character; while recent additions to the world's republics, due to the European War, include Austria, Czecho-Slovakia, Poland, and Germany.

Requena (re-ká'ná), a town of Southern Spain, in the province of Valencia. Industries are chiefly connected with saffron, grain, fruit, wine, and sericulture. Pop. 16,000.

Requests, Court of, an ancient court of equity, abolished in the reign of Charles I. The name was also given to tribunals of a special jurisdiction for the recovery of small debts, which were abolished, with a few exceptions, by the County Court Act of 1846.

Requiem is the name of a solemn Mass for the Dead. The name is derived from the opening sentence of the *Introit* in the liturgical service, "Requiem aeternam dona eis, Domine". The most important of earlier requiems is Palestrina's *Missa pro Defunctis* for five voices. Vittoria, Palestrina's great contemporary, also wrote a noble setting of the Requiem for six voices.

Of modern Requiem Masses the fine example by Mozart is probably the one most generally known, not only on account of its musical beauties, but also because of the highly mysterious and romantic circumstances under which it was written. Verdi's famous Requiem, written in memory of Manzoni, was first heard in 1874. It is written to the liturgical text, but is so dramatically conceived that it only gradually won its way to favour with the purists. Of works which have no connection with the words of the Mass, Brahms' *German Requiem*

is the outstanding example, being rightly famed for its lofty nature and great beauty of expression.

Rese'da, a genus of annual, biennial, and perennial herbs and undershrubs, nat. ord. Resedaceæ, of which it is the type. Of the genus two species are natives of Britain: *R. odorata* (mignonette) and *R. luteola* (wild woad).

Reseda'ceæ, a small natural order of plants, consisting of annual or perennial herbs, more rarely shrubs, with alternate or pinnately divided leaves, and small, irregular, greenish-yellow or whitish flowers. It inhabits Europe and all the basin of the Mediterranean. Most of the species are mere weeds.

Reserve. The Army Reserve, created by the Reserve Forces Act of 1882, consists of men who have completed their term of colour service (see *Enlistment*) and have then passed to the Reserve for the remainder of the period of their term of original enlistment. During their period of service in the Reserve—which varies from nine to five years, according to the length of colour service completed—a reservist remains liable to be recalled to the colours in case of a national emergency, and may also be called on periodically—usually every second year—for twelve days' training or a specified number of drills, during which time he may be attached to any battalion. Reserves are normally called up for colour service on emergency by Royal Proclamation, and, once called up, may be retained to serve in the army up to the limit of the unexpired portion of their term of original enlistment.

By an Act of 1890—still in force—men may be enlisted in the army, and immediately be transferred to the Reserve without serving with the colours; and it was under this regulation that, on the conclusion of the European War, when the Reserve had ceased to exist, a large number of men were specially enlisted to form the nucleus of a fresh Reserve.

Enlistment now is for the normal period of seven years with the colours and five in the Reserve, so that in course of time a new Reserve will be formed automatically. The Reserves, unlike the Territorials, can be called up for service in aid of the civil power.

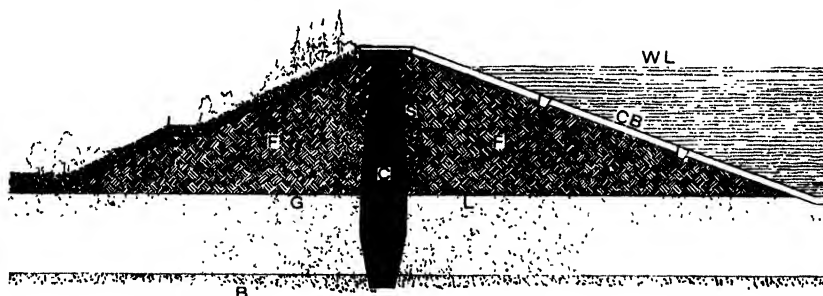
Reserve, of the Bank of England, is the security held by that institution to cover the amount of notes issued. For the week-end 7th Sept., 1921, the note-issue amounted to about £145,000,000; against this the Bank's 'reserve' consisted of the Government's debt of £11,015,000, other approved securities of nearly seven and a half millions, with gold coin and bullion to make up the balance of £126,000,000. By the Bank Act of 1844, which separated the bank's business into distinct issue and banking departments, the

institution was prohibited from issuing notes to an amount exceeding the value of gold in hand, less that of the above-named securities. The Bank Act was suspended in 1847, 1857, 1866, and 1914, in each case to meet financial crises; but in one case only was it needful for the bank to exceed its limit, the situation caused by the outbreak of war in 1914 being successfully met by the issue of Treasury notes. The banking department has also its 'reserve'; but this, taking the form of notes held against gold on the issue side of the house, is of comparatively small importance. The reserves of other banks are deposits with the Bank of England, or with banks which have deposits there. It will thus be seen that the reserve of the Bank of England is the foundation-stone upon which depends the stability of the whole financial fabric of the country. Prudently conducted joint-stock companies also make it a point of primary importance to build up a substantial 'reserve fund'; with this are met any sudden demands occasioned by bad trading years, opportunities for extending or developing the business, and (though this should be with caution) payment of dividends when these are not provided by current profits.

Res'ervoir, a basin, natural or artificial, in which water is collected and stored, usually to

forms a suitable main reservoir. Lakes situated far from the district to be supplied with water have been so used by many large cities. Manchester receives its water-supply from Lake Thirlmere, which is 96 miles away; and Glasgow obtains its requirements from Loch Katrine, 27 miles away from the distributing reservoir at Mugdock, which is 7 miles from the city. Dams have been erected across the gaps in valleys to create artificial lakes for use as reservoirs, e.g. that in the Vyrnwy Valley, in Montgomeryshire, used by the Liverpool Corporation (see *Dams*). Where earth is used for the construction of the dam, a wall of puddled clay is introduced into the middle of the bank to make the structure water-tight. A deep cutting is made for this wall right down to the rock foundation, and the clay, after kneading with water, is filled into the gap and pressed down. Sluices are arranged to regulate the supply water to the farms and works where water was used prior to the construction of the dam, and overflow outlets or waste weirs are made so that the dam may not be injured by the high-water level in times of flood.

A modern service reservoir is to be seen at Littleton, which is supposed to be the largest storage reservoir of its kind. This reservoir is one of the many used by the Metropolitan Water



Section of Reservoir Embankment

B, Clay bed or rock. C, Clay. F, Filling. S, Selected Material. CB, Concrete blocks.
WL, Top water level. GL, Ground level.

meet the requirements of a large town. The term is also applied to storage in open and closed tanks in many industries.

In the water-supply system of a large city there are two types of reservoirs: first, the main one in which the whole of the city supply is collected and stored, and, second, smaller distributing reservoirs situated in different places in the supply area. The smaller reservoirs are used to store the water coming through from the main reservoir during the night. As the two types are of different dimensions and are used for dissimilar purposes, they are quite different in construction. A large lake with its banks raised, if need be, by built-up earthwork

Board for district supply within their area. It has a capacity of approximately 6,750,000,000 gallons. The water is pumped from the Thames by single-stage centrifugal pumps.

Resht, a town of Persia, capital of the province of Gilan, connected with Tehran by a caravan road (150 miles). It was occupied by the British in Aug., 1918 (European War), and by Bolsheviks in Oct., 1920. Pop. 30,000–40,000.

Res'ina, a town of Italy, in the province of Naples, on the Gulf of Naples. It stands near Herculaneum, and is the usual starting-place for the ascent of Vesuvius. Pop. 20,000.

Resins are soft or hard vegetable secretions which are insoluble in water but more or less

soluble in essential oils, alcohol, ether, &c. They may be divided into true resins, gum resins, fossil resins, and balsams. These are all compounds of carbon, hydrogen, and oxygen, and consist mainly of complicated substances of an acidic nature related to various aromatic hydrocarbons.

The *true resins* are translucent, brittle substances with a vitreous fracture, and are bad conductors of electricity. They readily dissolve in alkalis, forming salts of a soap-like nature; for this reason they are largely used in soap manufacture. Common resin or colophony is prepared from turpentine by distilling off the essential oil which it contains. It is used in paper manufacture as a sizing agent, in the preparation of printer's ink, as a flux in soldering, and for many other purposes. Other resins of technical importance are dammar, copal, mastic, shellac, sandarac, and elemi (see separate articles). They are principally used in the preparation of varnish, which consists of a solution of a resin in oil of turpentine and methylated spirit.

Gum resins consist of a mixture of true resins and gums. See *Asafetida*; *Gamboge*; *Myrrh*; *Opoponax*.

Fossil resins are found in various countries, and consist of gums or balsams which have undergone resinification through the ages. See *Amber*; *Kauri Pine*. For the *balsams*, see *Balsam*; *Canada Balsam*; *Copaiba*; *Peru Balsam*; *Tolu Balsam*; *Turpentine*.

Synthetic resins are now largely used in the manufacture of lacquer varnishes. They are prepared from the cumarone and indene compounds present in coal-tar. These substances rapidly polymerize to form resinous bodies. By the action of formaldehyde (formalin) on certain organic oxy-acids and amines, resinous substances are also produced.

Resistance, Electrical, the physical property of materials which opposes the passage of electricity in quantity. (The present article supplements the account of the subject given in the article *Electricity*, under the sub-headings *Current Electricity* and *Measurement of Resistance*.) The unit of resistance is the ohm (q.v.), but large resistances, such as those of insulation material, are measured in units a million times greater, known as megohms. All materials have resistance, but there are some peculiar cases where apparently Ohm's Law (q.v.) does not apply. Such peculiar resistance actions are observed with gases and with certain crystals used in wireless telegraphy. Ionization (q.v.) actions cause changes in the electrical conductivities of gases. With certain crystals, for a given electromotive force more current can be passed through them in one direction than the reverse. This action is made use of in wireless

work to *rectify* currents, i.e. to convert alternating currents into currents moving in one direction only.

Two resistances AB and BC, having the end B of the first connected to the end B of the second, are said to be *in series*, and if they are connected to a supply of electricity, such as a battery, the current will pass through both in turn. If the resistances of the coils are R_1 and

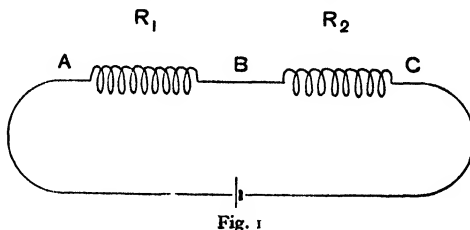


Fig. 1

R_2 , and the electrical potentials at the points A, B, and C are V_1 , V_2 , and V_3 respectively, when the current passing is i , then we can find the total resistance R of the external circuit. Applying Ohm's Law to the coil AB, we find $R_1 i = V_1 - V_2$. Also for the second part BC we deduce similarly that $R_2 i = V_2 - V_3$. By adding these two expressions we get $V_1 - V_3 = (R_1 + R_2)i$. If the combined resistance of the two coils is R , we know that $V_1 - V_3 = Ri$, and thus $R = R_1 + R_2$, or the equivalent resistance of the two coils in series is the sum of the separate resistances.

Two resistances joined in the manner shown in the second figure are said to be connected *in parallel*. In this case the current i from the source of supply divides, and a part i_1 goes through AB, and the remainder i_2 goes through

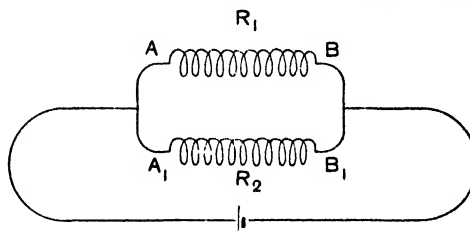


Fig. 2

$A_1 B_1$. The total current $i = i_1 + i_2$. If V_1 is the potential at A or A_1 , and V_2 the potential at B or B_1 , Ohm's Law gives the equations $R_1 i_1 = V_1 - V_2$, and $R_2 i_2 = V_1 - V_2$ for the two branches of the circuit. Consequently $i = i_1 + i_2 = (V_1 - V_2)(1/R_1 + 1/R_2)$. But $i = (V_1 - V_2)/R$; therefore $1/R = 1/R_1 + 1/R_2$, and $R = R_1 R_2 / (R_1 + R_2)$. It is obvious that the equivalent resistance of circuits in parallel

is less than either of the separate resistances. It is commonly necessary to calculate what fraction of the total current passes through any branch—a simple matter if it is remembered that the current is divided in the inverse ratio of the resistances. Each of the branches connected in parallel is said to be a *shunt* to the others. This term is, however, commonly restricted to certain applications, such as to ammeters, in which it is convenient to pass through the instrument only a certain fraction of the total current to be measured. If the whole current were passed through the ammeter, the coils would need to be of great cross-section. A single instrument may be used for testing in widely differing types of work, provided shunts corresponding to different ranges of currents are available.

In a general electrical supply system, mains are connected to the supply at their ends, and these mains are tapped at any point where electrical energy is required for the use of a house or factory. Just as there is a loss of head from point to point in a water supply pipe, so there is a drop in electrical pressure as points more and more distant from the source of supply are reached. There must be a drop in potential along the cables, otherwise no current would flow. This drop may be kept small by the use of thick cables, but that is only obtained by increased outlay for copper. Economy in transmission is obtained when certain sections are used for a given power distribution (see the reference to Kelvin's Law in the article on *Power Transmission*).

Res'onance, the vibration of a body in its natural period when caused by the absorption of wave-energy of the same frequency from an external source. It is a particular case of forced vibrations. When a vibrator is subjected to a periodic force, it ultimately vibrates with the same frequency as the force; if the period of the varying force coincides with one of the periods of vibration of the body (see *Harmonics*), resonant forced vibration, or resonance, takes place. Mechanical resonance is observed in the vibration of floors and bridges under the regular impulse of dancing or marching feet, in the rolling of a ship in a cross sea, and in the response of one pendulum to the action of another of equal period. The dark lines in the sun's spectrum are caused by a species of optical resonance. The efficiency of apparatus used in receiving wireless telegraphic signals depends on electrical resonance; the latter form may also occur in alternate current systems, causing undue strain to the insulation of the cables in which it takes place. If the waves which fall on a quiescent vibrator increase in frequency, resonance of the vibrator is observed with the approach

of the frequency to that of the vibrator; it increases to a maximum when the two are in unison, and dies down as the applied frequency increases beyond that of the vibrator. In sound, a sea-shell, Helmholtz resonator, or other hollow vessel, when held to the ear, reinforces any noises made in its neighbourhood, but resounds best to a particular note. The strings of a violin would not be heard but for the resonance of the body of the violin. The cavities of the mouth and nose act as resonance chambers for the voice. The resonance of a long hollow tube may be employed to measure the velocity of sound in air or in other gases, by determining the length of a tube, closed at one end, which resounds to a tone of known frequency. The wave-length of the sound is four times the length of the tube, or more accurately four times the length increased by four-tenths of the diameter of the tube, and the velocity of sound is the product of the frequency and the wave-length.

Goold has employed the principle of resonance in producing the tones of steel bars and plates. A 'synchronizer' is formed from a short length of cane with leather tip, clamped in a rigid holder, and with the same frequency as that of the bar or plate. By rubbing the bar with the synchronizer, a loud tone is produced with little effort. — **BIBLIOGRAPHY:** Poynting and Thomson, *Physics* (vol ii; *Sound*); E. H. Barton, *Sound*.

Resor'cinol, or **Resor'cin**, $C_6H_4(OH)_2$, a colourless crystalline substance melting at 110° C. It is prepared by fusing benzene *m*-disulphonic acid with potash. The substance is a dihydric phenol, and is used in large quantities in preparing fluorescein and azo dyes. Fluorescein with bromine yields tetrabromo-fluorescein, the potassium salt of which, $C_{20}H_6Br_4O_5K_2$, is the magnificent dye *eosin*, used for dyeing cotton, wool, and silk, and for making pink lakes and red ink.

Respiration, the act of respiring or breathing. Respiration is that great physiological function which is devoted to the purification of the blood by the removal, through the media of the breathing organs, of carbonic acid and other waste products, and at the same time to the revivifying of the blood by the introduction of the oxygen of atmospheric air. It is thus partly excretory and partly nutritive in its character. The other waste products, besides carbonic acid, which are given off in the process of animal respiration are water, ammonia, and organic matters; but carbonic acid is by far the most important.

In man and the higher animals respiration is carried on by the breathing organs or lungs. The blood is conveyed to the breathing organs by special vessels, the right side of the heart in birds and mammals being exclusively employed

in driving blood to the lungs for purification. The blood is sent through the pulmonary or lung capillaries in a steady stream, and passes through these minute vessels at a rate sufficient to expose it to the action of the oxygen contained in the air-cells of the lung. The essential part of the function of respiration, namely, the exchange of carbonic acid gas for oxygen, thus takes place in the lung, where the dingy-hued venous blood becomes converted into the florid red arterial blood. Respiration includes the physical acts of inspiration and expiration, both involuntary acts, although they may be voluntarily modified. From fourteen to eighteen respiratory acts take place per minute, the average quantity of air inhaled by a healthy adult man being about 30 cubic inches, a slightly smaller quantity being exhaled. This definite volume of air which ebbs and flows is termed *tidal* air. The quantity (about 100 cubic inches) which may be taken in a deep inspiration, in addition to the tidal air, is termed *complemental* air. The quantity of air (75 to 100 cubic inches) remaining in the chest after an ordinary expiration has expelled the tidal air is named *supplemental* or reserve air, and this may be in greater part expelled by a deeper expiration; whilst a quantity of air, also averaging from 75 to 100 cubic inches, always remains in the lungs after the deepest possible expiratory effort, and cannot be got rid of. This latter quantity is therefore appropriately named *residual* air. The difference in the mode of breathing between the two sexes is clearly perceptible. In man it is chiefly *abdominal* in its character; that is to say, the lower part of the chest and sternum, together with the abdominal muscles, participate before the upper portions of the chest in the respiratory movements; whilst in women the breathing movements are chiefly referable to the upper portions of the chest. In women, therefore, breathing is said to be *pectoral*.

Every volume of inspired air loses from $4\frac{1}{2}$ to 5 per cent of oxygen and gains rather less carbonic acid. The quantity of carbonic acid given off varies under different circumstances. More carbonic acid is excreted by males than by females of the same age, and by males between eight and forty than in old age or in infancy. An average healthy adult man will excrete more than 8 oz. of carbon in 24 hours.

While in man and the more highly organized animals respiration is carried on by the lungs, in fishes it is effected by the gills. The essential feature of any breathing organ is a thin membrane, having the blood on one side and air, or water containing air, on the other; and the essential feature of respiration is an interchange of products between the blood and the atmosphere, oxygen passing from the atmosphere into the blood, and carbonic acid and organic matters

from the blood into the atmosphere. In the protozoa no respiratory organs are specialized, but the protoplasm of which the bodies of these animals are composed has doubtless the power of excreting waste matters, as well as of absorbing nutritive material. Even in comparatively high organisms, where no specialized breathing organs are developed, the function of respiration may be carried on by the skin or general body-surface—the integument being, as in the highest forms, intimately correlated in its functions to the breathing process. Thus in earthworms, lower crustacea, &c., the breathing appears to be solely subserved by the body-surfaces.

Respiration, in plants, is fundamentally the same as in animals, and equally indispensable during active life, although, owing to the absence (with few exceptions) of special respiratory organs, and the complete lack of the muscular breathing movements which are so evident in the higher animals, it readily escapes observation. The gaseous interchange of respiring plants, however, can easily be demonstrated by enclosing a large number of germinating peas or dandelion heads in an air-tight vessel; if a lighted taper be introduced some hours later, it will be immediately extinguished, owing to the oxygen having been used up by the respiring plant-tissues, and the air in the vessel will turn clear lime-water milky, thus demonstrating the formation of carbon dioxide as one of the main products of respiration. A thermometer inserted among the peas or dandelion heads will in a short time stand a few degrees (in favourable cases 10° C.) above the room temperature, liberation of energy in the form of heat being another characteristic feature of active respiration in both plants and animals. See *Inter-cellular Spaces*; *Mangrove*.

Rest-harrow, a common British leguminous plant (*Ononis spinosa*), akin to the brooms. It is plentiful in stiff clay land in some parts, and derives its name from its long and strong matted roots arresting the progress of the harrow. The stems are annual, often woody or shrubby, and hairy; the leaves are generally simple, entire towards the base; the flowers, mostly solitary, large, and handsome, are of a brilliant rose colour. Rest-harrow is also called *cammock*.

Restiaceæ, a natural order of plants allied to the Cyperaceæ or sedges, and confined to the southern hemisphere, being found chiefly in South Africa and Australia. They are herbs or undershrubs, with matted roots which bind shifting soil, hard wiry stems, simple narrow leaves, the sheaths of which are usually split, and inconspicuous brown rush-like panicles of flowers. *Restio tectorum* is employed in South Africa for thatching, and the stems of other species are manufactured into baskets and brooms.

Restigouche (res'ti-gōsh), a river which separates New Brunswick from the province of Quebec, flowing north-east into Chaleur Bay at Dalhousie. It is 225 miles long, is navigable for 16 miles to Campbellton, and forms a tidal estuary for 24 miles. It drains 6000 sq. miles, and its basin supplies great quantities of timber.

Restraint, in law, may be (a) a restriction on marriage, or (b) a restriction on trade, but all such restrictions are frowned upon by the law as contrary to public morality and public policy. (a) As regards the former class, a provision that A shall receive a legacy only on condition that he shall not marry is bad as to the condition, and A may take the legacy without being so fettered. On the other hand, a provision giving the income of an estate or fund to A until his death or marriage, and thereafter to B, is perfectly good, and A on marriage forfeits the provision. (b) Conditions in restraint of trade are frequently met with in contracts for the sale of the goodwill of a business and in agreements of service. Quite naturally and reasonably, when a man purchases a business he desires to protect himself against competition by the seller; and an employer in whose service the knowledge of his business has been acquired, and the acquaintance of his customers gained, by an employee, wishes to restrain the latter from using that knowledge to his detriment, or taking away his customers, on quitting his service. If, therefore, the restraint imposed, as to time or area, is not injurious to the public nor more than is reasonably necessary in the circumstances of the case for the protection of the purchaser or master, it is valid and enforceable. Thus the restraints imposed on (a) a butcher who bound himself not to carry on his trade within 5 miles of the business which he had sold; (b) a solicitor not to practise within 150 miles of London; (c) a surgeon not to practise within 7 miles of a specified town; (d) a chemist's assistant not to carry on business within 1 mile of his master's shop; (e) a horse-hair manufacturer not to exercise his calling within 200 miles of Birmingham; and (f) a publisher not to carry on business within 100 miles of the General Post Office, London, have been held to be binding. Examples of restraints more than sufficient for the protection of the parties imposing them, and therefore held to be unenforceable, are the following: (a) on a local carrier not to carry on a similar business in the United Kingdom; (b) on a dentist not to practise within 100 miles of York; and (c) on a dentist's assistant not to exercise his profession within 200 miles of his employer's place of business.

Resurrection (Lat. *resurgere*, to rise again),

the rising again of the body from the dead to be reunited to the soul in a new life. It has formed a part of the belief of the Christian Church since its first formation, and has been embodied as an article in each of the creeds. There are traces to be found of such a belief among heathen nations from a very early period. There can be little doubt that the Jews, particularly those of later times, held the doctrine, though it would be difficult to point to any express indication of it in the Old Testament. It appears, however, to be alluded to in *Is.* xxvi, 19, and is distinctly affirmed in *Dan.* xii, 1-3. That the belief in the resurrection was generally held among the Jews at the time of Christ is evident, particularly from the position occupied by the Sadducees, a sect having as its most characteristic feature the denial of the resurrection. Beyond doubt, however, it was the gospel that "brought life and immortality to light". At best the notions of a resurrection and future state current prior to the advent of Christ were dim and undefined, and it remained for Him to set them in a full clear light, and give evidence and pledge of their reality by His own resurrection. With regard to the information conveyed to us in the New Testament on the doctrine of the resurrection, we are taught that it will be *universal*, extending to the wicked as well as to the righteous (*John*, v, 28, 29; *Rev.* xx, 13); that there shall be identity, in some sense, between the body which died and the body which shall be raised (*2 Cor.* v, 10); that, as regards the resurrection of the righteous, the body, though identical, shall be wonderfully altered (*Phil.* iii, 21; *1 Cor.* xv; *Luke*, xx, 35, 36); and that, as regards the time of the resurrection, it shall be at the end of this present earthly state, and that it shall be connected with the coming of our Lord to judge the world (*1 Thess.* iv, 16).

Connected with this subject is the resurrection of Christ himself from the dead, the corner-stone of the Christian system. The evidence in support of it is marked by the following characteristics: (1) *The variety of circumstances* under which the risen Saviour appeared. (2) *The circumstantiality* of the testimony given by the different witnesses. (3) *The simplicity and apparent truthfulness* with which the witnesses describe their impressions when the Saviour appeared to them. (4) *That the event borne witness to was completely unexpected by the witnesses.* (5) *That the testimony was published to the world on the very spot where, and at the very moment when, the event was said to have happened.* Various attempts have been made to explain away the resurrection of Christ. There is the supposition (1) of fraud; that, according to the statement of the Jews,

the disciples stole the body, and then published the story that their Lord was risen. (2) That Jesus had not really died on the cross; that His apparent death was only a swoon, from which He afterwards recovered. (3) That there had been no real resurrection, but that the disciples had been deceived by visionary appearances or hallucinations. (4) That the assertion of the resurrection was originally allegorical. With regard to the significance of the resurrection of Christ, it was (believers assert) the crowning evidence of the divine character of His mission; He himself had spoken of it as what should be the most convincing proof to the world that He really was what He professed himself to be; and in this light it was constantly and with irresistible conclusiveness appealed to by the Apostles in addressing the world.—BIBLIOGRAPHY: R. H. Charles, *Critical History of the Doctrine of the Future Life*; J. Orr, *The Resurrection of Jesus*; W. J. S. Simpson, *The Resurrection and Modern Thought*; B. F. Westcott, *The Gospel of the Resurrection*; A. L. Illingworth, *The Resurrection and the Life*; C. R. Bowen, *Resurrection in the New Testament*.

Resurrectionists, Resurrection Men, or Body-snatchers, persons who made a business of stealing newly buried corpses from graveyards and selling them to teachers of anatomy. The practice of body-snatching was prevalent in Britain during the latter half of the eighteenth and first half of the nineteenth centuries. Before the passing of the Anatomy Acts, many circumstances combined to render the practice of resurrectionism highly remunerative. The celebrated case of Burke and Hare revealed the fact that the more unscrupulous resurrectionists might also be systematic murderers, and led to the passing of the first Anatomy Act in 1832.

Retainer, in law, the contract between a solicitor and a client, or a solicitor on behalf of a client and counsel for professional services, and the document given by the solicitor to a counsel engaging his services. When the counsel is engaged for a particular suit, the document is called a *special retainer*; and when he is engaged for all matters of litigation in which such party may be at any time involved, it is called a *general retainer*. The retainer is in all cases accompanied by a preliminary fee called a retaining fee.

Retention of Urine in the bladder may be due to obstruction of the urethra, or to failure of the action of the muscles which bring about micturition. The former is caused by urethral stricture, calculus (stone), enlargement of the prostate gland, new growths of the bladder, and congestion of the urethra as the result of gonor-

rhœa or injury. There is also hysterical retention, due to spasm of the sphincter. Failure of action of the muscles results from injury and disease of the spinal cord, and partial or complete retention of urine is a symptom of many nervous diseases.

Retford, East, a municipal borough of Nottinghamshire, England, on the Idle; served by the Great Northern and Great Central Railways. It has foundries, paper- and corn-mills, rubber-works, &c. East Retford sent two members to the House of Commons from 1571 till 1885, when it ceased to be a parliamentary borough. Pop. (1921), 13,400.

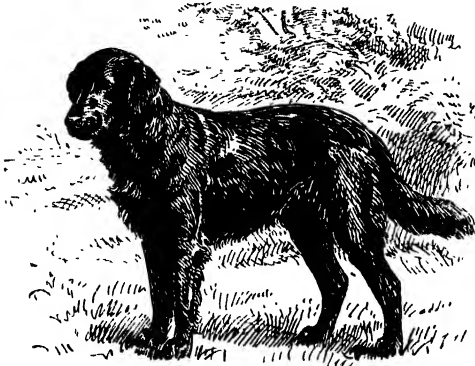
Ret'inite, a fossil resin of coaly appearance found in the lignite beds of Carniola and Styria.

Retort, a vessel used in the distillation of substances in chemistry and in industrial operations. The simple chemical retort of the laboratory is a flask-shaped vessel made of glass, earthenware, or metal, and provided with a neck to carry away the vapours which are produced when the substances in the flask are heated. Retorts of large size are used in the preparation and purification of various chemical substances, as well as in the separation of constituents which vaporize at different temperatures. The temperatures required for the distillation processes are the factors which must be considered in deciding whether the retort should be heated by direct flame contact or only by the contact of hot flue gases.

Gas-retorts may be either of the horizontal or vertical types. The old practice was to heat cannel in D-shaped fire-clay retorts, and take away the gases by means of cast-iron or cast-steel headers to the hydraulic main. With the high temperatures in use the tar produced is thick and heavy. This tar yields on distillation 60 to 70 per cent of pitch and 30 to 40 per cent of oils containing hydrocarbons, mainly of the benzene, naphthalene, and anthracene series. The tar produced when the distillation is carried out in vertical retorts is of a very different character. It is of lower specific gravity and of a much more oily nature, and yields on distillation 40 to 45 per cent of tar and 55 to 60 per cent of oils. The tar produced first is spoken of as low-temperature tar, and contains a large proportion of the paraffins; the tar produced later is similar to that obtained from horizontal retorts, and gives higher yields of the benzene series. Vertical retorts may be of the continuous or intermittent working types, or a combination of the two. See *Coal-Tar*; *Gas Manufacture*.

Retriever, a dog specially trained to fetch game which has been shot. The larger and more familiar breed of retrievers is formed by crossing

the Newfoundland and setter; the smaller breed is formed by crossing the water-spaniel and terrier. The typical retriever is 20 or more



Flat-coated Retriever

inches high, with a stoutly-built body, strong limbs, webbed toes, and black and curly fur.

Retz (rā), Jean François Paul de Gondî, Cardinal de, was born at Montmirail in 1613, died at Paris in 1679. Educated for the Church, he was appointed coadjutor to his uncle the Archbishop of Paris. He was the implacable enemy of Mazarin, and in 1648 became the most energetic and unscrupulous of the leaders of the Fronde. He received the cardinal's hat in 1651, but on Mazarin's return to power in 1652 he was arrested and imprisoned, first at Vincennes, then at Nantes. He escaped, however, after two years' captivity, and for nearly eight years wandered through Spain, Italy, Holland, Germany, and England. After the death of Mazarin in 1661 he was allowed to return to France, and became abbot of St. Denis. During the last seventeen years of his life he lived retired, paid his immense debts, and occupied himself with the composition of his *Mémoires*, which are inimitable for their historic truth and narrative skill.

Reuchlin (roi'h'lin), Johann, known also as *Capnion*, the Greek form of his name, German scholar, born in 1455 at Pforzheim, died in 1522. He studied at Freiburg, the University of Paris, Basel, and elsewhere, and became familiar with Latin, Greek, and Hebrew. He was patronized by several of the German princes, and was engaged on various political missions. From 1502 to 1513 he was president of the Swabian federal court. His opposition to the proposal to burn all Hebrew books except the Bible raised a host of fanatical enemies against him, but did him no harm. In 1519 he was appointed professor at Ingolstadt; in 1521 the plague drove him to Stuttgart. During a great part of his life Reuch-

lin was the real centre of all Greek and Hebrew teaching in Germany. Several of his works had considerable popularity in their time. He sympathized deeply with Luther and the Reformation, but maintained his connection with the Roman Catholic Church to the last.—Cf. L. Geiger, *Johann Reuchlin*.

Réunion (rā-û-ni-ōn), formerly Bourbon, a French island in the Indian Ocean, one of the Mascarene group, 420 miles east of Madagascar and 110 miles south-west of Mauritius; area, 970 sq. miles. It is very mountainous, the Piton des Neiges reaching a height of 10,069 feet, and the Piton de la Fournaise, an active volcano, of 8210 feet. There are about 150,000 acres of forest land. Sugar is the principal crop; rum, coffee, tapioca, spices, and vanilla are also produced. About 1,170,000 gallons of rum are distilled annually. Rice and grain are imported; exports are principally sugar and rum. There are about 80 miles of railways, the coastal line connecting the chief seaport, Pointe-des-Galets, with St. Benoît and St. Pierre. Cable communication is maintained by the Tamatave-Réunion-Mauritius telegraph cable. There are complete inland post-office telephone systems. St. Denis (pop. 1921, 21,538) is the capital; St. Pierre (27,900), St. Paul (19,500), and St. Louis (14,900) are the other chief towns. Réunion has a population of (1921) 173,200, 167,947 being Europeans (167,789 of French descent or origin), 2190 British Indians, 400 Madagascar natives, and about 2000 Chinese, Arabians, and Africans. Lying, as it does, so close to the Tropic of Capricorn, along which great cyclones are prevalent, it is visited by tornadoes of exceptional violence, and the plantations are frequently destroyed. The island sends one Senator and two Deputies to the French Assembly. France took possession of it in 1643 and has held it ever since, except during the British occupation of 1810-4.

Reus (rā-ûs'), a city of Catalonia, Spain, in the province of Tarragona, about 4 miles from the Mediterranean port of Salou. Reus is, next to Barcelona, the most flourishing manufacturing town of Catalonia, the staples being silk and cotton. Imitation French wines are largely made, and fruits and flour are exported. Pop. 25,000.

Reuss. See *Thuringia*.

Reuter, Paul Julius, Baron, born at Cassel in 1821, died at Nice in 1899. He was connected with the electric telegraph system from the beginning, and in 1849 established Reuter's News Agency at Aix-la-Chapelle. In 1851, on the laying of the cable between Calais and Dover, he transferred his chief office to London, and became a naturalized Britisher. As the telegraphic system extended he increased his

staff of agents, until the newspaper press, the foreign bourses, and all banking, shipping, and trading companies became dependent in a great measure on Reuter's Agency for the latest information from all parts of the world.

Reutlingen (roit'ling-ën), a town of Württemberg, 20 miles south of Stuttgart; has manufactures of cottons, woollens, lace, leather, &c. It is of considerable antiquity, and long maintained the rank of a free imperial city. It was incorporated with Württemberg in 1802. Pop. 29,000.

Reval, or Revel, the capital of Esthonia, on a small bay in the Gulf of Finland. It consists of two parts, the old or upper town, surrounded by walls and situated on a rocky height, and the lower town on the beach. Reval was an important seaport of the Hanseatic League, and came into the possession of Russia in 1710. It contains several ancient churches, a fine modern church with spire 429 feet high, a cathedral, and many interesting antiquities. Its manufactures are unimportant, but its trade is large, the exports being chiefly grain, flax, and spirits, and the imports, coal, iron, cotton, tea, wine, and chemicals. Reval was occupied by the Germans in Feb., 1918, and in 1919 a British naval force assisted the Estonians to repulse the Bolshevik army. Pop. 170,000.

Revelation, Book of. See *Apocalypse*.

Revenue. See *Taxation*.

Reverberatory Furnace, a furnace in which the material does not come into intimate contact

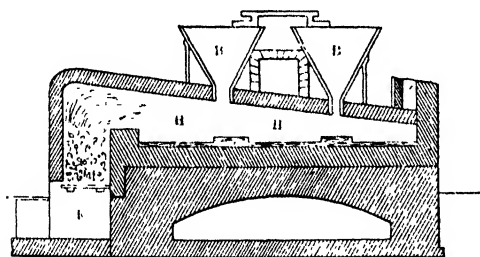
malleable iron by the puddling process. As air can be freely introduced above the surface of the heated materials in reverberatory furnaces, they are very suitable for the conversion of metallic salts, such as sulphides, into oxides, which actions usually take place at temperatures much below those of fusion. Such furnaces are employed in alkali manufacture, in the production of sodium carbonate by the black-ash process, but it is common nowadays to use a reverberatory furnace of the revolving type for this purpose.

Reverend, a title of respect given to clergymen and other ecclesiastics. In England bishops are *right reverend*, archbishops *most reverend*, deans *very reverend*, and the ordinary clergy *reverend*. In Scotland the principals of the universities, if clergymen, are *very reverend*, and the moderator of the General Assembly *right reverend*; all the other clergy are simply *reverend*.

Revet'ment (Fr. *revêtement*), in field engineering, any material formed into a retaining wall to support earth at a steeper slope than the natural one, which is about 45°. It is necessary in almost all entrenchments or earthworks (see *Entrenchments*). The materials usually employed in revetments are grass sods, sand-bags, or stakes interwoven with brushwood or wire netting. Hurdles and fascines are also used. See *Fascines*.

Revival, a term applied to religious awakenings in the Christian Church, and to the occurrence of extensive spiritual quickening and conversion in the general community. The first great revival in Europe was the Reformation in the sixteenth century, which awoke the Church from the sleep of centuries. When religion had degenerated into formalism in England in the seventeenth century, a second revival of spiritual interest was accomplished through the instrumentality of the Puritans. When the Church had once more sunk into a state of sloth and apathy in the eighteenth century, it was aroused by the preaching of Whitfield, the Wesleys, Rowland Hill, Venn, Newton, Cecil, Fletcher, and a multitude of other earnest men. Among later revivals may be mentioned that of Moody and Sankey (1873); and that of 1904-5 in Wales, which was largely due to the influence of a young miner, Evan Roberts. The Salvation Army, which was originated in 1865 and organized under its present name in 1878, may be regarded as a permanent revival organization. Another revival was that of 1921 among the fishing population in Scotland. See *Salvation Army*.—BIBLIOGRAPHY: C. G. Finney, *Revivals of Religion*; J. Burns, *Revivals: their Laws and Leaders*; W. T. Stead, *The Revival in the West*.

Revocation, in law, the destroying or annulling of a deed or will which had existence till the act of revocation made it void. The



Reverberatory Furnace for calcining copper ores

HH, Hearth. F, Fire-place. BB, Hoppers.

with the fuel, the flames from a separate fire being passed over the substance to be heated. The flames pass over the fire-bridge, which divides the furnace from the fire, and are deflected downwards from the curved roof. Where a certain depth of material is to be maintained, a flue-bridge is arranged at the end of the furnace, where the chimney is situated. There are two main types, of which the first is the melting or fusion type, and the second is the calcining or roasting furnace. The first type is used in the reduction of lead and tin ores, in the refining of silver and copper, and in the manufacture of

revocation of a deed can generally be effected only when an express stipulation has been made in the deed itself reserving this power, or in the case of a contract by mutual consent. The revocation of a will can be made in four different ways: (1) by a codicil revoking the will in whole or in part or by another will; (2) by intentional burning, or the like; (3) by the disposition of the property by the testator in his lifetime; (4) by marriage. In Scotland a will may be revoked by the birth of a child to the testator.

Revolver. See *Pistol*.

Rewah, a native state in the eastern region of the Baghelkhand agency of Central India, divided into two natural zones by the scarp of the Kaimur range. The northern division produces rice, maize, wheat, grain, barley, and native food grains. Forests are extensive, and the jungles are noted for their tigers; antelope, bears, and leopards also being met with. The jungles have made communication exceedingly difficult, but the Jubbulpore extension of the East Indian Railway and the Katni-Bilaspur section of the Bengal-Nagpur line traverse the state. Baghel-khandi is the prevailing language, and is spoken by over 90 per cent of the people, who are mainly Hindus (Brahmans, Kunbis, Chamars, and Telis); Animists and Mahomedans are also represented. There are four towns, Rewah (pop. 25,600), Satna (7000), Umari, and Govindgarh (about 5000 each). Rewah is the capital. State area, 13,000 sq. miles; pop. 1,516,000.

Rewa Kantha, a confederation of sixty-one native states in India, forming a political agency subordinate to the Government of Bombay. The principal state is Rajpipla; others of importance are: Bariya, Chota Udaipur, Lunavada, Balasinor, and Sunth. The inhabitants are mainly of nomadic, Bhil, or Koli origin, Kolis predominating. Area, 4070 sq. miles; pop. 480,000.

Rewari, a town of India, in the Gurgaon district of the Punjab; the junction of the trunk line with the Rewari-Bhatinda branch of the Rájputána-Malwa Railway. Brass and pewter have been made from time immemorial; grain and sugar are important trade commodities, sent mainly to Rájputána; salt and iron are forwarded to the United Provinces. Rewari came under British administration in 1809. Pop. 27,250 (Hindus and Mahomedans).

Reynolds, Sir Joshua, English portrait-painter, was born at Plympton, Devonshire, 16th July, 1723, died in London 23rd Feb., 1792. He first worked for two years under Thomas Hudson, a Devonshire man then popular in London as a portrait-painter, and subsequently studied in Italy for three years. Returning to London in 1753, his studio soon became thronged

with the wealth and fashion of the metropolis, and the most famous men and the fairest women of the time were among his sitters, so that he rapidly became the acknowledged head of his profession. Among the more notable of his portraits are: the *Duchess of Hamilton* (1758), *Admiral Keppel*, *Lord Heathfield*, *Miss Palmer* (1770), *Mrs. Nesbitt as Circe* (1781), *Dr. Johnson*, *Mrs. Siddons as the Tragic Muse* (1784), the *Duchess of Devonshire and Child* (1786), and *Miss Gwatkin as Simplicity* (1788). In 1768, on the foundation of the Royal Academy, he was chosen president, and received the honour of knighthood; and in 1784 he was appointed principal portrait-painter to the king. As president of the Royal Academy he delivered his celebrated 'Discourses on Painting', the last of which was delivered in 1790. He was the intimate friend of Dr. Johnson, Goldsmith, Garrick, Burke, and other literary celebrities, with whom he was associated in founding the 'Literary Club' in 1764. His portraits are distinguished by dignity and dramatic power, though they are sometimes empty and rhetorical. His colour, based on that of the great Venetians, has in most cases faded badly, owing to carelessness in use of his materials. As an historical and religious painter, in works such as *The Death of Cardinal Beaufort*, *Macbeth*, *Puck*, and several Holy Families and Nativities, Reynolds was not a success. He is fully represented in the National and Tate Galleries, and in many English private collections.—BIBLIOGRAPHY: W. Cotton, *Sir Joshua Reynolds and his Works*; J. Northcote, *Life of Sir Joshua Reynolds*; J. F. Molloy, *Sir Joshua Reynolds and his Circle*; Sir W. Armstrong, *Sir Joshua Reynolds, First President of the Royal Academy*; Graves and Cronin, *History of the Works of Sir Joshua Reynolds*.

Reynolds, Osborne, British engineer and physicist, was born at Belfast in 1842, died in 1912. He was professor of engineering in Owens College, Manchester, from 1868. He became a Fellow of Queens' College, Cambridge, and F.R.S. in 1877, and was awarded a gold medal by the Royal Society in 1888. He was the author of a large number of papers, some of them of the highest importance. Among the subjects on which he wrote were: the theory of lubricants, the critical velocity at which the steady motion of a fluid becomes turbulent, and the sub-mechanics of the universe. His collected works have been published in three volumes.

Rhadamanthus, in Greek mythology, the son of Zeus and Europa, and brother of Minos, King of Crete, whom he assisted in his sovereignty, and whose jealousy he aroused by his inflexible integrity, which earned for him the admiration of the Cretans. Rhadamanthus subsequently fled to Bœotia, where he married

Alcmene. After his death he became, on account of his supreme justice, one of the three judges of the lower world.

Rhæ'tia, a province of the Roman Empire, which included great part of the Alpine regions between the valleys of the Danube and the Po, and corresponded with the districts occupied in modern times by Tyrol and the Swiss canton of Grisons. The Rhætians, who are generally supposed to have been of Etruscan origin, were subdued by Drusus and Tiberius, 15 B.C.; and shortly afterwards Rhætia was incorporated as a province in the Roman Empire. During the last days of the Roman Empire, when the barbarians devastated the provinces, Rhætia was nearly depopulated; and after the fall of the Roman Empire it was occupied by the Alemanni and Suevi.

Rhæ'tic Beds, in geology, the uppermost strata of the Triassic, often regarded in England as the lowest of the Liassic series; most extensively developed in the Rhatian Alps, whence their name. See *Trias*.

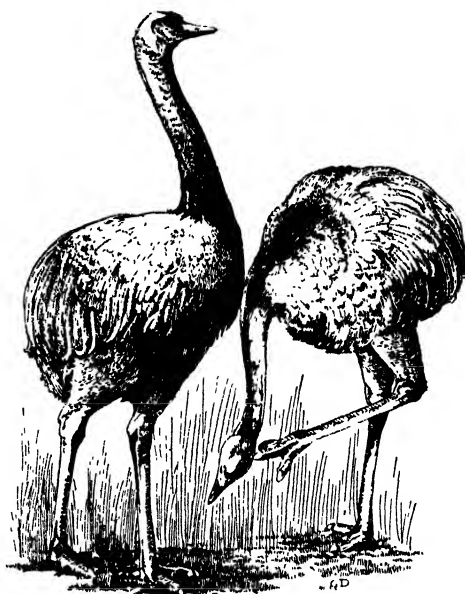
Rhamna'ceæ, a natural order of polypetalous dicotyledons, consisting of trees or shrubs, with simple, alternate, rarely opposite leaves, small greenish-yellow flowers, a valvate calyx, hooded petals, opposite to which their stamens are inserted, and a fruit which is either dry or fleshy. This order contains about 250 known species, distributed very generally over the globe. There is a remarkable agreement throughout the order between the properties of the inner bark and the fruit, especially in several species of *Rhamnus*, in which they are both purgative and emetic, and in some degree astringent. Many species, however, bear wholesome fruit; and the berries of most of them are used for dyes (see *French Berries*). The buckthorn and jujube belong to this order.

Rhap'sodists (from Gr. *rhapō*, to string together, and *ōdē*, a song), the wandering minstrels among the ancient Greeks, who sang the poems of Homer (these were also called *Homeridæ*) and of other poets. They were highly respected so long as the poems were handed down orally, but as soon as the MSS. of the poems began to be circulated their influence and importance diminished considerably.—Cf. H. Browne, *Homeric Study*.

Rhea, in Greek mythology, one of the most distinguished of the Titanides, the daughter of Uranos and Gē (Heaven and Earth), sister and wife of Cronos (Saturn), and mother of Hestia (Vesta), Dēmētēr (Ceres), Hera (Juno), Hades (Pluto), Poseidon (Neptune), and Zeus (Jupiter). She received the appellation of 'Mother of the Gods', and 'Great Mother', being subsequently identified with Cybele.

Rhea, the generic name of the nandu or South

American ostrich, a close ally to the true ostrich, differing chiefly in having three-toed feet and each toe armed with a claw. The best-known species is *R. americana*, the *nandu*, or *nanduguaçu*, of the Brazilians, inhabiting the great South American pampas. It is considerably smaller than the



Rheas

true ostrich, and its plumage is much inferior. *R. darwini*, a native of Patagonia, is still smaller. The third species is the *R. macrorhyncha* of North-East Brazil, so called from its long bill.

Rheims, Fr. **Reims** (ancient, **Durocor-torum**), a town of France, in the department of Marne, in an extensive basin surrounded by vine-clad hills. The principal buildings are the cathedral, begun in 1241, one of the finest mediæval structures now existing in Europe, specially remarkable for its western façade with three portals, rose-window, and innumerable figures; the archiepiscopal palace (1498–1509), occupied by the French kings on the occasion of their coronation; the church of St. Remy (eleventh and twelfth centuries), the oldest church in Rheims, which was badly damaged in 1918; the fourth century *Porte de Mars*, a Roman triumphal arch erected in honour of Julius Cæsar and Augustus. The *Maison des Musiciens* (fifteenth century) and the *Hôtel Dieu* were demolished during the European War. The staple industries are the manufacture of champagne, and of woollen fabrics, such as flannels, merinoes, and blankets. Pop. (1921), 76,650.

Rheims (*Durocortorum*) was an important place in the time of Cæsar, the capital of the Remi, and subsequently of Belgic Gaul. Here St. Remy converted and baptized Clovis and almost all the Frankish chiefs in 496. It was made the seat of an archbishop in the eighth century, and from the time of Philip Augustus (1179) to that of Charles X the Kings of France were crowned here. It has suffered much from war, and was at one time in possession of the English, who were expelled by the Maid of Orleans in 1429. It was held by the Germans in 1870-1. After the Franco-German War it was surrounded by detached forts, which made it a place of great strength. During the European War Rheims was entered by the Germans (4th Sept., 1914), who sacked the town. They retreated after the Allied victory of the Marne, but bombarded the city almost continuously from Sept., 1914, till Oct., 1918. The cathedral was so badly damaged as to necessitate a measure of restoration after the conclusion of peace. For the battle of Rheims, see *European War (Third Phase of Ludendorff's Offensive)*.

Rheingau (rin'gou), a picturesque district of Prussia, district of Wiesbaden, on the right bank of the Rhine, between Biebrich and Rüdesheim, about 12 miles long by 5 miles broad, noted for its wines.

Rhenish Prussia, Rhineland, or Rhine Province, a western frontier province of Germany, in Prussia; area, 9470 sq. miles, pop. 6,770,000 (or 714·8 per square mile, showing Rhineland to be the most densely populated province of Germany, excepting Berlin). Birkenfeld, an appanage of Oldenburg, is an enclave of the province, and has an area of 194 sq. miles.

Physiography.—The northern portion of the province forms a part of the Rhine plain, the remainder being hilly. The rivers with few exceptions belong to the Rhine system, and that river itself forms the boundary of the province for 230 miles. Within the province the right bank tributaries are the Lahn, Sieg, Wupper, Ruhr, and Lippe; on the left, the Moselle, with its affluent the Saar (see *Rhine*). The drainage area of the Rhine water-way system is over 80,000 sq. miles. The climate is oceanic, with an even rainfall and no extremes of heat or cold, contrasting strangely with the semi-continental conditions endured by Eastern Germany. The Rhine Valley is the warmest place in Germany; July is the wettest month, January and February the driest.

Towns.—Cologne (Köln; pop. 1919, 633,900), Essen (439,260), Düsseldorf (407,340), Duisburg (244,800), Elberfeld (157,220), and Coblenz (capital, 56,487). Most of these have grown upon their actual sites as a consequence of some specially favourable geographical conditions,

such as the proximity of valuable natural resources or main lines of communications.

Communications.—The Schiefergebirge or Slate Mountains are divided into sections by the three valleys of the Rhine, Moselle, and Lahn, and all traffic, whether by road, rail, or river, must of necessity pass through them. From its width and straightness, and from its position, which offers a direct route through the mountains from South and Central Europe to the Netherlands and the ocean, the Rhine Valley is naturally of premier importance. The river itself is the principal water-way, and a number of important river-ports lie on its banks, tapping the adjacent industrial regions. Chief among these is Duisburg, tapping the Rhenish-Westphalian and North Krefeld coal-fields. Duisburg includes the sub-ports of Alsum, Walsum, Homberg, and Rheinhausen. Others are: Düsseldorf, Cologne, Neuss, Wesel, Wesseling, Leverkusen, Krefeld, Beuel (opposite Bonn), and Ober Lahnstein. There are 4750 miles of railways, owned and operated by the Prussian system, of which they form a part. Before the European War there were many lines of no economic importance whatever, and as they all converged on the southern frontier, their purpose seems obvious.

Production: Agriculture.—Crops include barley, hay, oats, potatoes, rye, spelt (German wheat), and wheat. Fruits include apples, pears, plums, cherries, peaches, apricots, and walnuts. There are four wine districts: Rhine, Nahe, Moselle, and Ahr. **Forestry.**—There are several forest zones, notably in Northern Eifel, Hunsrück, and Moselle. **Fisheries.**—Salmon is found in the Rhine, and trout in the hill streams. **Minerals.**—About one-quarter of the coal deposits of the great Rhenish-Westphalian coal-field lies within the province, but most of the coal mined in Germany comes from the Ruhr Valley, situated almost entirely in Westphalia. Essen, however, in the left-hand corner of the coal basin, is in Rhineland. There are several smaller fields, the North Krefeld, Wurm-Inde (and the Saar) being of most importance. There are also valuable lignite (brown coal) deposits. Iron ore occurs all over the Schiefergebirge; copper is found, usually in association with lead; manganese, nickel, silver (with lead), zinc, potash salts (Stassfurt), sulphur and basalt, slate, and pottery clay are all more or less worked.

Manufactures.—These include iron and steel goods of all kinds, textiles, chemicals, paper, clothing, pianos and furniture, leather goods, glassware, cement, bricks, and beer.

Rheostat, the term applied to a resistance in an electric circuit which is so constructed that the value of the resistance actually in use can be varied at will. The word is applied to small resistances, such as are commonly used in elec-

trical test work. A simple rheostat for such a purpose may be made by coiling German silver wire in grooves cut in a slate cylinder and providing a contact piece, supported above the coil, by means of which any or all of the resistance may be included in the circuit. In commercial test work resistances of great magnitude are required, and these are made of wire, cast-iron grids, banks of carbon-filament electric lamps; or tanks filled with water in which some salt or soda is dissolved, and with which iron plates form the contact pieces.

One of the most common uses of rheostats or resistances is in the starting and regulating of electric motors. When an electric motor is started, there is nothing but the ohmic resis-

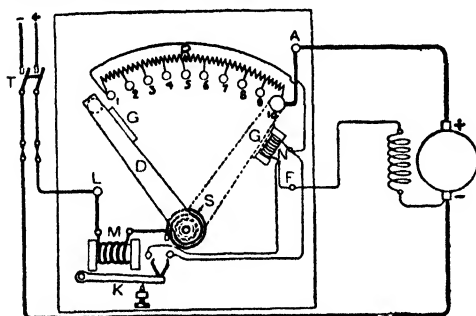
the magnetic field is weakened in this way, the motor speed will increase.

For methods of starting alternating-current motors of the induction type, see *Induction Motor*.

Rhesus Monkey, a name for the *Macacus rhesus*, a species of monkey held sacred in North India, where they swarm in large numbers about the temples.

Rhet'oric, in its widest sense, may be regarded as the theory of eloquence, whether spoken or written, and treats of the general rules of prose style, in view of the end to be served by the composition. In a narrower sense rhetoric is the art of persuasive speaking, or the art of the orator, which teaches the composition and delivery of discourses intended to move the feelings or sway the will of others. In the wider sense rhetoric treats of prose composition in general, purity of style, structure of sentences, figures of speech, &c.; in short, of whatever relates to clearness, preciseness, elegance, and strength of expression. In the narrower sense it treats of the invention and disposition of the matter, the character of the style, the delivery or pronunciation, &c. Aristotle, Cicero, and Quintilian are the principal writers on rhetoric among the ancients; and among the English, Campbell, Blair, Whately, Spalding, and Bain.

Rheumatism, an ailment or set of ailments accompanied by sharp pains, especially in the joints. Some varieties of it have so much resemblance to gout that some physicians have considered it as not an entirely distinct disease. Rheumatism is distinguished into *acute* and *chronic*. The former is characterized by fever (*rheumatic fever*), pains in the joints, which are swollen, red, and tender, and sweating. The inflammation flits from one joint to another, one joint getting well when another is attacked; and the pain may be very severe. The entire duration of an attack, if not treated, may be from two to six or ten weeks, and disease of the heart may be a consequence of this disease. Chronic rheumatism is distinguished by pain and stiffness, either stationary or shifting, in the joints, without fever. It is aggravated by damp weather, and is seldom quite got rid of. Salicylate of soda and iodide of potassium are the chief drugs prescribed. Rheumatism may arise at all times of the year, when there are frequent vicissitudes of the weather from heat to cold, but spring and autumn are the seasons in which it is most prevalent; and it attacks persons of all ages, but very young people are less subject to it than adults. Obstructed perspiration, occasioned either by wearing wet clothes, lying in damp sheets or damp rooms, or by being exposed to cool air when the body has been much heated



Shunt-motor Starter

A, Positive brush terminal. D, Switch arm. T, Positive field terminal. G, K, Armatures. L, Terminal of starter. N, 'No-voltage release' electromagnet. M, 'Overload release'. R, Starting resistance. S, Spring. T, Main switch.

tance of the armature to prevent the passage of very large currents. After the machine is running the coils of the armature rotate in the magnetic field, and a back electromotive force is generated. Consequently, unless some means are taken to avoid great rushes of current in starting, the full-load currents may be exceeded. The introduction of resistance into the armature circuit at starting is the means adopted to overcome this trouble. As the speed of the machine increases the starting resistance may be gradually reduced, for the back electromotive force restricts the amount of current passing through the armature. In shunt- and compound-wound motors, the starter is so arranged that the moment the starter handle is turned current is passed through the shunt-field coils; afterwards current is passed through the armature, the latter current also passing through the series coils in a compound-wound machine. Step by step the resistance in the armature circuit is cut out until the machine is running at full speed.

Moderate changes in the speed of running of an electric motor may be obtained by the insertion of resistance in the field circuit. When

by exercise, is often cited as the cause which produces rheumatism. But it is now very widely held that diseased conditions of the teeth may cause 'chronic rheumatism' by the absorption of septic matter into the circulation and the damage inflicted by it on the joints.

Rheydt (rit), a town and railway junction of Rhenish Prussia, on the Niers. It manufactures cotton, silk, woollen, and mixed fabrics, and has some distilling and brewing activities. Rheydt is an ancient place, but has risen to industrial importance only in recent times, mainly through its proximity to the Westphalian coal-fields. Pop. 44,000.

Rhigas, Constantine, Greek poet, the first mover of the war for Grecian independence, was born about 1754, died in 1798. He formed the bold plan of freeing Greece from the Porte by means of a great secret association, and composed in his native language a number of patriotic songs, calculated to inflame the imagination of the Greek youth and to embitter them against the Moslems. Arrested by the Austrians and surrendered to the Turks, he was executed at Belgrade. During the Greek war of independence, which ultimately led to the emancipation of their country from the Turkish yoke, Rhigas's songs were in the mouth of everyone.

Rhin, Bas-, the former district of Lower Alsace, which, in accordance with the Treaty of Versailles, is now a department of France. Cap. Strasbourg. Area, 1848 sq. miles; pop. 651,590.

Rhin, Haut-, a department of France; area, 1354 sq. miles; pop. 468,940 (or 346.3 per square mile). Haut-Rhin was constituted a department in 1790, and was annexed with the rest of Alsace by Germany after the Franco-Prussian War of 1870-1, excepting the arrondissement of Belfort, which remained in France. With Colmar for capital it formed the German district of Upper Alsace, and was restored to France by the Treaty of Versailles.

Rhinan'thus, a genus of annual herbs, nat. ord. Scrophulariaceæ, with opposite serrate leaves and nodding spikes of yellow flowers. The species are confined to the northern hemisphere, and are parasitic on the roots of plants. Two of them are British, and are known by the name of *yellow-rattle*.

Rhine (Ger. *Rhein*; Du. *Rijn*), one of the most important rivers of Europe, its direct course being 460 miles and its indirect course 800 miles (about 250 miles of its course being in Switzerland, 450 in Germany, and 100 in Holland); while its catchment area covers 75,000 sq. miles. It is formed in the Swiss canton Grisons by two main streams called the Vorder and Hinter Rhein. The Vorder Rhein rises in the Lake of Toma, on the south-east slope of the St. Gothard, at a height of 7600 feet above the sea, near the source

of the Rhone, and at Reichenau unites with the Hinter Rhein, which issues from the Rheinwald Glacier, 7270 feet above sea-level. Beyond Reichenau, which is 7 miles west of Coire, the united streams take the common name of Rhine. From Coire the Rhine flows north through the Lake of Constance to the town of that name, between which and Basel it flows west, forming the boundary between Switzerland and Germany. At Basel it turns once more to the north to form the Franco-Baden frontier and is entirely within Germany from Mörsch northwards until it enters Holland below Emmerich, when it divides into a number of separate branches, forming a great delta, and falling into the sea by many mouths. The chief of these branches are the Waal and Lek, which unite with the Maas; the Yssel and Vecht, which diverge to the Zuider Zee; and that which retains the name of Rhine, a small stream that passes Leyden and enters the North Sea. In the middle part of its course the chief tributaries it receives on the left are the Ill, Nahe, Moselle (with the Saar), Ahr, and Erft; and on the right the Neckar, Main, Lahn, Sieg, Ruhr, and Lippe. In Switzerland its tributaries are short and unimportant, and this part of its course is marked by the Falls of the Rhine at Schaffhausen, where the river is precipitated in three leaps over a ledge of rocks 48 to 60 feet in height, and by the cataracts of Lauterberg and the rapids of Rheinfelden. The chief towns on its banks are Constance and Basel in Switzerland; Spire, Mannheim, Mainz, Coblenz, Bonn, Cologne, and Düsseldorf, with Worms, in Germany; Strasbourg in Bas-Rhine; Arnheim, Utrecht, and Leyden in Holland. Its breadth at Basel is 750 feet; between Strasbourg and Spire from 1000 to 1200 feet; at Mainz 1500 to 1700 feet; and at Emmerich, where it enters the Netherlands, 2150 feet. Its depth varies from 5 to 28 feet, and at Düsseldorf amounts even to 50 feet. It abounds with fish, especially pike, carp, and other white fish, but the produce of its salmon fisheries has been seriously interfered with since the introduction of steamboats. It is navigable without interruption from Basel to its mouth, a distance of 550 miles, and much timber in rafts, coal, iron, and agricultural produce are conveyed by it. Large sums are spent every year in keeping the channel in order, and in the erection or repair of river harbours, both in Germany and Holland. Steamboats ply not only on the Rhine, but also on the Main, the Neckar, the Maas, and the Moselle. The Rhine anciently formed the boundary between the Roman Empire and the Teutonic hordes. After the partition of the domains of Charlemagne in 843 it lay within the German Empire for nearly 800 years. France long cast covetous eyes upon the Rhine, and the Peace

of Westphalia in 1648 gave her a footing upon the left bank. In 1801 the whole of the left bank of the Rhine was formally ceded to France. The Congress of Vienna in 1815 restored part of the Rhenish valley to Germany, and the cession by France of Alsace and Lorraine after the war of 1870-1 made the Rhine once more German. By the Treaty of Versailles (1919) the Upper Rhine frontier was recovered by France. It was also decided that the river should become a free water-way under the control of an international commission. The Rhine is distinguished by the beauty of its scenery, which attracts many tourists. The finest part for scenery is between Bingen and Bonn. The Rhine enters the Rhineland at Bingen, and leaves it at the Dutch frontier, 101 miles from the sea. Moderate rapids occur just below Bingen and at other places between Bingen and Neuwied, but do not hinder navigation. The current in the Bingen-Königs-winter section demands the use of powerful tugs for upstream traffic, which moves at from $2\frac{1}{2}$ to $3\frac{1}{2}$ miles per hour. After entering Holland the views are generally tame and uninteresting.

Rhinobat'idæ, the shark-rays or beaked rays, a family of elasmobranch fishes, intermediate in form between sharks and rays, and having a very wide distribution in tropical and subtropical seas.

Rhinoceros, a genus of hoofed mammals, belonging to the perissodactylate or odd-toed division, allied to the tapir, and less closely to the horse. They are large ungainly animals, having short legs, and a very thick skin, which is



Indian Rhinoceros (*Rhinoceros indicus*)

usually thrown into deep folds. There are seven grinding teeth on each side of each jaw; there are no canines, but there are usually incisor teeth in both jaws. The feet are furnished with three toes each, encased in hoofs. The nasal bones usually support one or two horns, which are of the nature of epidermic growths, somewhat analogous to hairs. When two horns are present, one, generally the shorter of the two, is placed

behind the other. These animals live in marshy places, and subsist chiefly on grasses and foliage. They are exclusively confined to the warmer parts of the eastern hemisphere. The most familiar species is the one-horned or Indian rhinoceros (*Rhinoceros unicornis* or *indicus*), which, like all the Asiatic species, has the skin thrown into very definite folds, corresponding to the regions of the body. The horn is black, and usually very thick. The upper lip is very large, and is employed by the animal somewhat as the elephant uses his trunk. Though possessed of great strength it is quiet and inoffensive unless provoked. It is now confined to the Assam plain. The Javanese rhinoceros (*R. sondaicus*) is distinguished from the Indian chiefly by its smaller size. It occurs in Burmah, the Malay Peninsula, Java, Sumatra, and Borneo. The Sumatran species (*R. sumatrensis*), the smallest living one, is found in Sumatra and the Malay Peninsula. It has two horns, the first being the longer and sharper. The typical African rhinoceros (*R. bicornis*), once abundant throughout South Africa, is now extinct in Cape Colony and the Transvaal. It is still found in Eastern and Central Africa. Like the other African species, it possesses no skin-folds. The horns are of very characteristic conformation, the front horn being broad and raised, as on a base, sharp-pointed, and curved slightly backwards, whilst the hinder horn is short and conical. This animal appears to be of ferocious disposition, is quick and active, and is greatly feared by the natives. The only other African species is the so-called white rhinoceros (*R. simus*), now practically extinct. Fossil species are numerous, and range from the Miocene downwards. *R. tichorhinus*, the 'woolly rhinoceros', formerly inhabited England and ranged over the greater part of Europe. Extinct related genera date back to the Upper Eocene.

Rhizoctonia, a genus of parasitic Basidiomycetous Fungi, producing their basidia in irregular layers on the surface of the host. *Rh. solani* and *Rh. violacea* cause two forms of 'scab' on potatoes. Several others form the mycorrhiza (q.v.) on orchid roots.

Rhi'zoid, in botany, a hair- or thread-like structure which acts as a simple form of root in plants (Thallophytes, Mosses, Fern-prothalli) which do not possess genuine roots.

Rhi'zome, in botany, a subterranean stem, usually more or less horizontal, outwardly often resembling a root, but always bearing leaves or scales.

Rhizop'oda, the lowest class of the Protozoa, comprehending animals which are destitute of a mouth, are uninucleate or multinucleate, and possess the power of protruding pseudopodia. They are all minute or microscopic animals, the largest being only one-fiftieth of an inch in

diameter. Structurally the rhizopods consist of a mass of protoplasm, and are devoid of special organs. The characteristic from which they have their name is their capability of protruding processes (pseudopodia) from any part of their substance, sometimes as filaments or threads and sometimes finger-shaped, and retracting them at pleasure. Some are invested with a horny or siliceous shell of simple nature. See *Protozoa*.

Rhode Island, a maritime state in the New England division of the United States, and the smallest state in the Union. *Physiography*.—The most striking physical feature is Narragansett Bay and its offshoots, which are drowned river valleys. Within the bay are numerous islands, including Rhode Island, from which the state derives its name. Rivers are short and swift, and, although of little volume, they are harnessed for hydro-electric power. The state is covered with rounded hills of low elevation, but is nowhere mountainous. Climatic conditions are good, and there are no great extremes of heat or cold. *Towns*.—There are thirty-nine cities and towns. Providence (pop. 1920, 237,595) is the state capital; other cities are: Pawtucket (64,250), Woonsocket (43,500), Newport (30,260), Cranston (29,400), Central Falls (24,180), and East Providence (21,800). *Social Conditions*.—Of a population of 604,000, over 594,400 are white, and of that number 25,780 are English, 5700 Scots, 22,000 Irish, about 36,000 Canadian, 32,000 Italian, and 3200 German. Roman Catholics predominate, with Baptists, Protestant Episcopalians, and Congregationalists next. *Production*.—Rhode Island is a manufacturing state, producing textiles and rubber, and elastic goods. It ranks fifth in the United States for cottons, third for woollens, and sixth for silks. Graphite, lime, and stone are worked. There is some farming. *Education*.—Education is compulsory between five and fifteen years of age. There is a State College of Education. The Brown University at Providence is sectarian (Baptist). A College of Agriculture and Mechanic Arts is also maintained by the State. *Area, &c.*—The state area is 1248 sq. miles, 180 sq. miles being water. The population (1920) was 604,397, 10,036 being negro. There are five counties (Washington, Newport, Kent, Providence, and Bristol). *Government*.—There is a Governor, who exerts executive power. The General Assembly comprises a Senate (39 members) and a House of Representatives (100 members). 2 Senators and 3 Representatives are sent to Congress.

History.—Rhode Island State was settled by political refugees from Massachusetts (1636), and the colony was chartered by Charles II (1663) as 'Rhode Island and Providence Plan-

tations'. The colony played an important part in the War of Independence, and was one of the original thirteen states of the Union, accepting the Federal Constitution on 29th May, 1790. 28,800 men were provided by Rhode Island State for service during the European War, and over £40,000,000 were subscribed towards American war loans.

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Rhodes (rōdz), Cecil John, British imperial statesman, born 1853, died 1902. He was the son of a clergyman who held the living of Bishop Stortford, Herts. In 1871 diamonds were discovered at Kimberley, and, with his brother, Cecil Rhodes went to the 'diggings', where, towards the close of the year, he made a large fortune, being then eighteen years of age. In 1880 he was associated with Rothschild in the flotation of De Beers Mining Company, and in 1881 he entered the Cape Assembly, championing the proposal for an autonomous state under the imperial flag, which should be the nucleus of an ever-spreading British hegemony in Africa, as opposed to the Boer ideal of federation as an independent state. A British colony and protectorate over Bechuanaland was established in 1885, mainly through the efforts of Rhodes. On the establishment of the British South Africa ('The Chartered') Company he became a director (1889), and was Cape Prime Minister from 1890 until the Jameson Raid (1896), when he was censured by the Assembly and resigned. He quelled the Matabele rising of 1896, and after being shut up in Kimberley during the siege (1899–1900), his health again broke down, and he died at Muizenberg, near Cape Town, on 26th March, 1902, and was buried at his special request among the Matoppos Hills. The work of Cecil Rhodes as an 'empire builder' has been carried on to the present day by the foundation of 175 scholarships value £300 each, tenable at Oxford University by young colonials, and the whole of his fortune of £6,000,000 has been devoted by his orders to the furtherance of the ambitions which he cherished and fought for throughout his brilliant career.

Rhodes, an island in the Ægean Sea, off the south-west coast of Asia Minor, separated from it by a channel 10 miles broad; area, 560 sq. miles. It is traversed by a mountain range, the highest point of which is 4786 feet. Great part of the island is occupied by hills, which are covered with woods of ancient pines. Grain, grapes, figs, pomegranates, oranges, &c., are produced. Pop. 81,000.

Rhodes was a celebrated island in antiquity. It was settled by Dorians from Greece, and the Rhodians soon became an important maritime people, and for several centuries the island was a great seat of literature, art, and commerce. In A.D. 44 it was made part of the Roman province of Asia. It is famous for its prolonged defence by the Knights of St. John from 1309 till 1522, when they were forced to abandon the island to the Turks. Rhodes was occupied by Italy in 1912, and was ceded to that country by the Treaty of Sèvres.

Rhodes, the capital of the Island of Rhodes, stands at the north-eastern extremity of the island, rising from the sea in the form of an amphitheatre, with fortifications mainly the work of the Knights of St. John. There are few remains of the ancient city, which was founded by the Dorians in 408 B.C., one of the most splendid of ancient Greek cities. The celebrated Colossus of Rhodes stood for fifty-six years, and was prostrated by an earthquake in 224 B.C. (see *Colossus*). Pop. 10,000.

Rhodesia, a British possession in Africa, deriving its name from Cecil Rhodes (q.v.). It extends northwards between the Transvaal and Tanganyika Territory, and is divided into the two provinces of Northern and Southern Rhodesia respectively.

Physiography.—Rhodesia forms a high plateau lying between 3500 and 5000 feet above sea-level, but much lower in the river valleys. In Southern Rhodesia some 100,000 sq. miles of territory lie over 3000 feet altitude, and 2600 sq. miles are above the 4000-feet contour line. There are three distinct Rhodesian zones: (1) bush and scrub country; (2) broken ranges of low hills and isolated wooded kopjes; (3) wide, grassy, treeless plains. Physically, Northern Rhodesia forms a part of Central Africa, and the southern province is part of South Africa, so that the latter is a white man's country and Northern Rhodesia is not, and it is necessary, therefore, to treat the provinces separately as far as possible.

Northern Rhodesia.—This province lies north of the Zambezi, and south of Tanganyika and the Belgian Congo. Area, 290,000 sq. miles; pop. about 932,000. There are 3500 Europeans located mainly at Fort Jameson and along the railway to Victoria Falls. There are ten magisterial districts policed by a native force under European officers and non-commissioned officers. The trunk line of the Rhodesian Railway system enters the province at Livingstone, and runs northwards to the Congo frontier. The telegraph system is connected with the railway. Livingstone is the capital; other stations are Abercorn, Fort Rosebery, Ndola, Broken Hill, and Lealui. The chief rivers are the Zambezi, Kafue, and Chambezi, all more or less navigable. Lake

Bangweulu and part of Lakes Tanganyika and Mweru are within the province. Cotton, maize, tobacco, cereals, rubber, and fruits are produced; gold, lead, zinc, and copper are worked, and coal has been found. Northern Rhodesia belongs mainly to the Zambezi basin, and is a suitable farming country, but some 60,000,000 acres are dominated by the tse-tse fly (causing sleeping sickness), and malaria and blackwater are fairly prevalent. October to March or April is the wet season. There is plenty of big game.

Southern Rhodesia.—This province lies north of the Limpopo and south of the Zambezi, and is crossed from south-east to north-west by the Matoppos Hills. Area, 149,000 sq. miles; pop. (native), 770,000; (European), 33,500. Salisbury is the capital; Bulawayo, Umtali, Victoria, Gwelo, Enkeldoorn, Hartley, Melsetter, Gwanda, Tatooma, and Ilukwe are other towns. The Rhodesian Railway system begins at Vryburg (Bechuanaland) and runs along the western edge of the Limpopo Valley to Bulawayo, at which the line bifurcates, one fork traversing the western regions to Malindi, the Wankie coal-fields, and Livingstone (Northern Rhodesia), and the other running north-east to Gwelo (branches to Selukwe and Victoria), Salisbury (branches to Ayrshire, &c.), and Beira in Portuguese East Africa. The principal rivers are the Zambezi and Limpopo. Climatically, Southern Rhodesia is healthy except in some low-lying valleys, where 7,000,000 acres are dominated by the tse-tse fly. Winter lasts from April to September, when the nights are frosty and ice may form occasionally, but in the highlands the winter is decidedly invigorating. In summer (October to March) the heat is never oppressive, and a cool evening usually follows a hot day. The wet season proper lasts from December till March, but some rain falls in winter. (Climatic conditions are, of course, variable, particularly so in Southern Rhodesia, which is half the size of Europe. The province is eminently suitable for agricultural and grazing purposes. Nearly all fruit-trees thrive, and oranges are rapidly becoming a valuable source of wealth. They are exported mainly to the United Kingdom. Cattle, sheep, and goats are bred. Rhodesia is the world's greatest producer of asbestos after Canada, the principal fields (1922) being at Mashaba and Shabani, on the Sabi River. Gold, copper, tin, lead, antimony, and coal are extensively found and worked.

History.—The name Rhodesia was officially adopted in 1895. The modern history of Rhodesia begins with Chaka, the King of the Zulus, who condemned Mosilikatse, the Matabele chief, to death in 1817; Mosilikatse fled to the Transvaal, where he was unsuccessfully attacked by Dingaan, Chaka's successor, and eventually fled beyond the

Limpopo. Lo Bengula succeeded Mosilikatse, his father. The Transvaal Boers were preparing to trek northwards to occupy Lo Bengula's territory beyond the Limpopo, when, in 1889, a charter was granted to the British South Africa Company, and a year later a force occupied Fort Salisbury in their name. The Matabele rose in rebellion in 1893; after two pitched battles

who originally came from Matabeleland, but were conquered in 1840 by the Makololo, a Basuto tribe, led by Sebetuana, one of Chaka's indunas. In 1864 the Barotse revolted under King Sepopopa, and the Makololo were exterminated. Sepopopa's nephew, Lewanika, consolidated his power in 1885, and by the Anglo-Portuguese treaty of 1891 came under British rule. The capital of the kingdom is Lealui.

Barotseland is a native state or reserve, and no Europeans or others, excepting the officials of the Chartered Company and such missionaries and traders as are approved by the chief, may settle there.

During the European War the Caprivi (German South-West Africa) concession was occupied by Rhodesian forces, and now forms the 'corridor' between Southern Rhodesia and South-West Africa. The frontier of German East Africa (now Tanganyika Territory) marched with that of Northern Rhodesia between Lake Tanganyika and the head of Lake Nyasa, by which opening the Germans entered the country, which was held against them by Rhodesian volunteers, assisted by troops from the Belgian Congo, the British South Africa Police, and a Matabele contingent. Rhodesian battalions supported General Northey's offensive, and subsequently served in the South-West and East African campaigns. On 2nd Nov., 1918, von Lettow-Vorbeck and the exhausted remnants of the flying German Field Force entered Rhodesia, and surrendered to the magistrate at Kasama on 14th Nov.

Government.—Rhodesia is administered by the British South Africa Company. In Southern Rhodesia there is an Administrator appointed by the Company, and assisted by an Executive Council of not less than 3 members. Ordinances may be passed by a Legislative Council comprising the Administrator and 18 members (12 elected and 6 nominated); a Resident

Commissioner is appointed by the Secretary of State. He has a seat in both Councils, but may not vote. Northern Rhodesia is administered by an Administrator appointed by the Company, and assisted by an Advisory Council of 5 members chosen by white settlers. Imperial interests are represented by a Resident Commissioner. One Commissioner may hold commissionerships for both divisions. During 1922 agitation was revived for the setting up of a suitable elective form of government. See *South Africa, Union of; Rhodes, &c.*

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with the Chartered Company's forces, Bulawayo was taken. On the death of Lo Bengula the following year, the country became pacified.

Rhodesia, as thus occupied, consisted of Matabeleland in the south, with Bulawayo as capital, and Mashonaland in the north, with Salisbury as capital. Two more provinces were added, viz. North-Western Rhodesia, with Kalomo as capital, and North-Eastern Rhodesia, bordering Nyasaland, with Fort Jameson as capital. In 1911 these two northern provinces were united, and the capital moved to Livingstone, just north of the Victoria Falls. The Barotse Valley, an immense plain, is occupied by the Barotse nation,

by L. W. Lyde and Irene J. Curnow: Gresham Publishing Company); A. S. and G. G. Brown, *South and East African Year Book and Guide* (annual with orographical maps); C. Gouldsbury and H. Sheane, *The Great Plateau of Northern Rhodesia*; David Livingstone, *Missionary Travels* (1857).

Rho'dium (chemical symbol, Rh; atomic weight, 102·9), an element discovered by Wollaston in 1804, and called rhodium on account of the bright-rose colour of the solutions of its salts. Rhodium belongs to the platinum group of metals, and occurs along with platinum and iridium in platinum ores. The metal is silvery-white in colour, has the ductility of silver, and resembles aluminium in general appearance. When pure it is not attacked by mineral acids, but if mixed with platinum or other metals it becomes soluble in aqua regia. If heated in air for a considerable time, it is converted into the oxide RhO, and if heated in an atmosphere of chlorine, it is transformed into a dark-red solid, rhodium trichloride (RhCl₃). The metal is used for making crucibles and electric pyrometers.

Rhododen'dron, a genus of evergreen shrubs with alternate, entire leaves, and ornamental flowers disposed in corymbs, belonging to the Ericaceæ (heaths), and chiefly inhabiting mountainous regions in Europe, America, and Asia. The colours of the flowers range through rose, pink, lilac, scarlet, purple, red, and white. *R. chamæcistus*, *R. ferrugineum*, and *R. hirsutum* grow on the Alps. The chief cultivated species are: *R. maximum* and *R. catawbiense*, from North America; *R. ponticum*, from Asia Minor; *R. dahuricum*, from Siberia; *R. racemosum* and *R. Fortunei*, from China; *R. campanulatum*, from the Himálaya; *R. caucasicum*, from Caucasia; and their hybrids.

Rho'donite, a mineral manganese silicate, one of the pyroxenes, of a rose-red colour, and used, when massive, as an ornamental stone.

Rhodope (rō'do-pē), the ancient name of a range of mountains belonging to the Balkan system, partly in and partly south of Eastern Roumelia; culminating point, Muss Allah (9615 feet altitude).

Rhodophyceæ. See *Red Algæ*.

Rhondda, an urban district of Glamorgan-shire, South Wales, in the valley of the Rhondda River, a tributary of the Taff; served by the Taff Vale and Great Western Railways. It is a great coal-mining centre. Pop. (1921), 162,729.

Rhone (rŏn; Lat. *Rhodānus*), a river which rises in Switzerland, in the east of the canton of Valais, taking its origin in the Rhone Glacier, 5581 feet above the sea-level. It passes through the Lake of Geneva, and enters France, flowing first southwards and then westwards to the city

of Lyons, where it turns almost due south, and so continues till (after passing Avignon and Arles) it falls into the Gulf of Lyons by the extensive delta of La Camargue. Its principal affluent is the Saône, which enters it at the city of Lyons; other tributaries are the Isère, Durance, Arve, and Drôme. Its whole course is about 500 miles; its drainage area is 38,000 miles; and it is navigable upstream as far as Lyons. By means of a series of magnificent canals the navigation of the Rhone has been continued, without interruption, to the Rhine (through the Saône), Seine, and Loire, and to the Meuse and the Belgian system.

Rhône, a department of France, forming part of the pre-Revolutionary provinces of Lyonnais and Beaujolais, in the basin of the Rhône, to which it sends its waters by the Saône (with the Aazergues) and the Gier; area, 1104 sq. miles. The wealth of the department is derived from its manufactures, the chief of which is silk, others being cottons and woollens, linens, machinery, and metal goods. The city of Lyons is the capital. Pop. (1921), 956,566 (or 866·5 per square mile).

Rhubarb (Rheum), a genus of plants belonging to the nat. ord. Polygonaceæ. The species of this genus are large-leaved herbaceous plants, natives of a considerable portion of Central Asia, with strong branching, almost fleshy roots, and erect branching stems 6 to 8 feet high. They usually possess more or less purgative and astringent properties. The principal kinds of medicinal rhubarb have received such names as Russian or Turkey, East Indian, Himálayan, Chinese, and English, according to their source or the route by which they have reached Europe. At present most of the Asiatic rhubarb comes from China, the plant yielding it being mostly *R. officinale*. English rhubarb is derived from *R. Rhaponticum*, which has long been cultivated for medicinal purposes in some parts of England as well as on the European continent. The leaf-stalks of this species, as well as of *R. undulatum* and others, are now largely used for tarts, puddings, jam, &c., and the juice is made into a kind of wine.

Rhyl (ril), an urban district and watering-place of Flintshire, North Wales, near the mouth of the Clwyd; served by the London & North-Western Railway. There is a fine sandy beach, a pier, and winter-gardens. Pop. (1921), 13,000.

Rhyme, Rhime, or Rime, in poetry, the correspondence of sounds in the terminating words or syllables of verses. The vowel and the final articulations or consonants should be the same in sound. The initial consonants ought to be different. In languages which have not a great variety of shades between the sounds of

a, e, i, o, u (pronounced as in Italian) writers adhere strictly to this rule; that is to say, the corresponding syllables have exactly the same vowel sound. English writers have allowed themselves certain licences, and we find in the best English poets rhymes which strike an accurate ear as incorrect. In some instances, such as *sky* and *liberty*, *hand* and *command*, *gone* and *alone*, the correspondence in the letters makes what might be called a rhyme to the eye, which supplies, in some measure, the want of correspondence in sound. In other instances, however, this is not the case, as in *revenge* and *change*, *remote* and *thought*. Such rhymes may be tolerated if they only occur at rare intervals, but they must certainly be regarded as blemishes, and are carefully avoided by all who wish to write harmoniously. If the rhyme is only in the last syllables, as in *forgave* and *behave*, it is called a masculine rhyme; if in the two last syllables, as *bitter* and *glitter*, it is called a feminine or double rhyme. Sometimes the last three syllables rhyme, as *callosity* and *reciprocity*, or the Italian *diacine* and *duracine*, or *tavola* and *favola*. This is called a triple rhyme, in Italian *verso sdrucciolo*. This last sort of rhyme is principally used in pieces of a comic or conversational character. Rhymes which extend to more than three syllables are almost confined to the Arabians and Persians in their short odes (gazelles), in which the same rhyme, carried through the whole poem, extends sometimes to four and more syllables. Some languages incline more to the masculine rhyme, as English, on account of its superabundance of monosyllables; others, as Spanish and Italian, more to the feminine; German and French possess an almost equal store of both. The feminine rhymes in French all contain an *e* mute in the last syllable, and from the beginning of the sixteenth century it has been the almost uniform practice among French poets in dramatic, heroic, elegiac, satirical, and other forms of poetry to make couplets of masculine rhymes alternate with others of feminine rhymes.

The modern use of rhyme was not known to the ancient Greeks and Romans. We meet, indeed, with some rhymed verses in Ovid, in which the rhyme was evidently intentional; but these examples are rare. It has been used, on the other hand, from time immemorial among the Chinese, Hindus, Arabs, and other Oriental nations. Rhyme began to be developed among Western nations in the Latin poetry of the Christian Church. It was employed as early as the fourth century, and in subsequent centuries it became so prevalent that *carmen rhythmicum* acquired the sense of 'rhymed poem', and *rhythmus* came to be used for 'rhyme'. The most ancient relics of Teutonic and Scandinavian poetry are not in rhyme, but are distinguished by allitera-

tion. The earliest use of rhyme in a Teutonic dialect is in Otfried's *Evangelij*, written in Frankish, in the latter half of the ninth century. The oldest forms of rhymed verse are the couplet and the continuation of one and the same rhyme through a whole piece. Sometimes rhymes occur at the middle and end of a verse. Such verses are called *leonine*. The Troubadours first attempted a variety of artificial combinations of rhyme in the sonnet, canzone, &c., and the Spaniards and Italians, with their musical languages and delicacy of ear, perfected the forms of involved rhyme. The Italians, however, at a later period, carried the artificial intricacies of rhyme to great excess.

Rhymer, Thomas, of Erceldoune, or Earlstoun, in Berwickshire, otherwise called *Thomas the Rhymer*, was a half-legendary Scottish poet or romancer of the thirteenth century. He is mentioned by Barbour, Blind Harry, and Wyntoun, was credited with prophetic powers, and his *Prophecies*, a collection of oracular rhymes, were long popular in Scottish folk-lore. The old metrical romance of *Sir Tristram* is doubtfully ascribed to him.

Rhymney (rim'ni), a town of Monmouthshire, England, on the River Rhymney (which enters the Severn); served by the Great Western and Rhymney Railways. There are large iron- and steel-works, including blast-furnaces and rolling-mills. Pop. (1921), 11,090.

Rhynchonella (rin-ko-nel'la), a genus of lampshells (Brachiopoda). Over 400 fossil species are numbered from the Ordovician upward, but only four living species are known, inhabiting the deeper parts of the oceanic areas.

Rhynia, a very remarkable genus of extinct Pteridophytes, recently discovered in the Carboniferous or Devonian chert of Rhynie, in Aberdeenshire, not unlike *Psilotum* (see *Psilotales*), but of even simpler structure. These plants render the gap between Bryophytes and Pteridophytes somewhat less formidable than it had appeared previous to their discovery.

Rhyolite, a rock occurring in dykes or as lavas, flows, named from its frequently exhibiting a fluidal or banded structure, owing to its viscous nature when in a molten state (Gr. *rhéein*, to flow). Its composition is the same as that of granite, and the high percentages of silica (about 72) and of potassium and sodium allow the mass to retain a considerable amount of glass on cooling. Rhyolites were formerly called quartz-trachytes.

Rhythm is identified by poets and philosophers with the whole life of man and with the universe in which he finds himself; but as a practical factor of daily existence it must be limited in definition to the realm of sound, in which it acts as a controlling agent. This it does by

regulating the recurrence of the systems of accents which form so essential a part of all sound-making, whether in speech or music; and its effect is not less felt even in the case of a book which is read silently. The 'inner ear' of the reader is still either acutely conscious or sub-consciously aware of the rhythmic scheme as the eye reads on, and, when this perception is sufficiently cultivated, can as quickly resent any clumsy departure from the accepted laws as it can enjoy the inspired observance of them. In the realm of language the rhythmic scheme of prose is of a very subtle kind, and does not readily submit to classification. Nevertheless, its effects are easily to be discerned, and according as it is present or absent the prose is felt to be good or bad. In the musical world the compositions of the contrapuntal-choral era are analogous to prose so far as rhythmic structure is concerned. All music of a meditative cast from any period, and the great bulk of all modern music, is also of the prose category. Indeed it is just this subtlety of rhythmic structure which so frequently stands in the way of the more immediate acceptance of important new works. The rhythmic schemes of poetry and of simple folk music, and music founded on the dance, may be regarded as alike in the comparative obviousness of their structure, and also in the innumerable variations from the standard schemes which have been devised. These variations from normal rhythm, of which music is specially full, are not only useful in avoiding monotony, but are in themselves a source of artistic pleasure of the highest kind. For a very full discussion of rhythm in its musical relation, see Prout's *Musical Form*, published by Novello.

Rhytina, a genus of sirenian mammals, closely allied to the manatee and dugong, which became extinct before the eighteenth century closed. The only species of *Rhytina* (*Rhytina stelleri*) was discovered in 1741 by the Russian naturalist Steller on an island in Behring Straits. The animals were fish-like in shape, and of great size—specimens measuring 25 feet in length and 20 feet in greatest circumference.

Rhytisma, a genus of Ascomycetous Fungi, group Discomycetes. *Rh. acerinum* is a common parasite on the sycamore, causing the large black patches which disfigure the foliage of that tree in most parts of Britain.

Rib, the name given to the curved bones which in man and the other vertebrates spring from either side of the spine or vertebral column, and which may or may not be joined to a sternum or breast-bone in front. The ribs ordinarily agree in number with the vertebræ of the back or dorsal region. Thus in man twelve dorsal vertebræ and twelve pairs of ribs exist. The *true* or sternal ribs are the first seven, which are articulated at

one extremity to the spine, and at the other to the sternum by means of cartilages. The *false* or short ribs are the remaining five; the uppermost three being united by their cartilages to the cartilage of the last *true* rib. The others are free at their sternal extremity, and hence have been called 'floating ribs'. Ribs are wanting in such lower fishes as lampreys, lancelets, &c., and in amphibians such as frogs and toads. The number of these bones may be very great in certain species, and they are occasionally developed in the cervical and pelvic regions in reptiles and birds respectively.

Ribble, a river of Yorkshire and Lancashire, rises at Wharfedale Mountain, and flows generally south and south-west till it expands below Preston into an estuary of the Irish Sea; length, 75 miles.

Ribbon, a narrow web, generally of silk, either natural or artificial, used for tying and ornamental purposes. Ribbon-weaving is a special branch of the textile industries. In modern looms as many as forty ribbons are simultaneously woven in one machine. Ribbon-weaving was established near St. Etienne, in France, in the eleventh century. In England Coventry is an important seat of this industry, which is also carried on at Norwich and Leicester. Mixed fabrics of silk and cotton are now largely employed.

Ribbon-fishes, the name of certain deep-sea teleostean fishes met with in all parts of the ocean, generally found floating dead on the surface, or thrown ashore by the waves. They make up a special family (*Trachypteridæ*). The body is like a band, and may be as much as 20 feet long, 10 to 12 inches broad, and 1 to 2 inches thick. These fishes are generally silvery in colour. The fin rays in young ribbon-fishes are extraordinarily developed, some of them being several times longer than the body. The deal-fish (*Trachypterus arcticus*) is often met with in the North Atlantic, and is sometimes found after gales on the Scottish coasts. It may be 8 feet or more long. See *Deal-fish*; *Oar-fish*.

Ribbon-grass, or **Canary-grass**, a garden variety, striped with green and white, of *Phalaris arundinacea*, a grass which is found in its wild state by the sides of rivers.

Ribbonmen, the members of a secret society organized among the Roman Catholics in Ireland about the beginning of the nineteenth century in opposition to that of the Orangemen. It originated in Armagh, and spread thence to Down, Antrim, Tyrone, and Fermanagh. The organization of the society was similar to that of the Orangemen, but by no means so complete. The membership from the first was drawn almost exclusively from the lowest classes

of the population. The 'Molly Maguires' (q.v.) were a branch of the Ribbonmen.

Ribes, a genus of plants of the nat. ord. Grossulariaceæ, comprehending the gooseberry and the currants. A species with scarlet flowers (*R. sanguineum*), and a variety of this with white flowers, are much cultivated as ornamental shrubs.

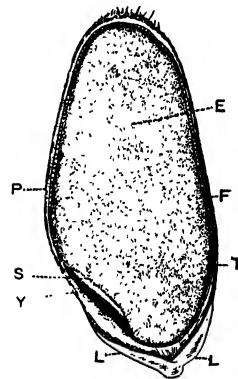
Ribot, Théodule Armand, French psychologist, born in 1839, died in 1916. He devoted his attention to experimental and physiological psychology, especially at the clinics of lunatic asylums. In 1888 he was appointed to the chair of experimental psychology in the Collège de France. He founded the *Revue Philosophique* in 1876, and did valuable and important work in the field of psychopathology.

Ricar'do, David, British political economist, of Jewish descent, born in London in 1772, died in 1823. He published an *Essay on Rent*, and his name is usually associated with a certain distinctive view on this subject. But his most important work is his *Treatise on Political Economy and Taxation*, which appeared in 1817. He belongs essentially to the school of Adam Smith.—Cf. J. H. Hollander, *David Ricardo*.

Riccia, a large genus of Liverworts, representing the simplest type of the family Marchantiales. The species are small plants growing on mud or floating on stagnant water.

Rice (*Orīza satīva*), a cereal plant, nat. ord. Graminaceæ or Grasses. This important food-

Asia, Egypt, Japan, part of the United States, and in several districts of Southern Europe. The culm of the rice is from 1 to 6 feet high, annual, erect, simple, round, and jointed; the leaves are large, firm, and pointed, arising from very long, cylindrical, and finely striated sheaths; the flowers are disposed in a panicle somewhat resembling that of the oat; the seeds are white and oblong, but vary in size and form in the numerous varieties. In the cultivation of this plant a high summer temperature is required, combined with abundance of water. Thus the seaboard areas and river deltas which are subject to inundation give the best conditions, otherwise irrigation is necessary. In Egypt rice is sown whilst the waters of the Nile cover the land, and the plant grows luxuriantly in the rich alluvial deposit left by the receding flood. The Chinese obtain two crops a year from the same ground, and cultivate it annually on the same soil, and without any other manure than the mud deposited by the water of the river used in overflowing it. The young plants



Longitudinal Section of Unhusked Rice Grain

P, Palea. S, Scutellum
Y, Embryo. L, Empty glumes.
T, Testa. F, Flowering glume.
E, Endosperm.

are transplanted into ploughed furrows, and water is brought over them and kept on till the plants begin to ripen. The first crop is cut in May, and a second is immediately prepared for by burning the stubble; this second crop becomes ripe in October or November. In India two harvests are obtained in the year, especially in Bengal, and frequently two crops are taken from the same field. In Japan, Ceylon, and Java rice is cultivated much in the same manner. Mountain rice is a hardy variety which thrives on dry soil; and in India it is cultivated at an altitude of 8000 feet. Rice can be profitably cultivated only in warm countries, but has for some time past been grown in South Germany and Italy. In the United States it is grown chiefly in the swampy districts of South Carolina, Georgia, and Louisiana. In the husk rice is known by the name of 'paddy' (i.e. *Padi*). Rice is more largely consumed by the inhabitants of the world than any other grain (except perhaps millet); but the percentage of nitrogenous or flesh-forming matter in it is only 7. The European supply of rice comes from India (and especially from Burmah), Siam, French Indo-



Rice (*Orīza satīva*)

1, Panicle. 2, One-flowered spikelet.

plant was known in the East long before it was introduced into Egypt and Greece. It is now cultivated extensively in the low grounds of the tropical and sub-tropical parts of South-Eastern

China, Java, and Japan principally. The fermented liquors made from rice include *saki* in Japan and *arack* in the East Indies. *Rice starch* is now extensively manufactured, and the straw is made by the Japanese into straw-plait.

Rice-bird, a name given to two distinct birds. The first, also known by the name 'bob-o'-link', is *Dolichonyx oryzivorus*, a bird of the bunting family, which migrates over North America from Labrador to Mexico, appearing in Massachusetts about the beginning of May. Its flesh is similar in flavour to that of the ortolan. The other rice-bird is *Munia oryzivora*, also known as the Java sparrow and paddy bird. It belongs to the true finches, a group nearly allied to the buntings. It possesses a largely-developed bill; the head and tail are black, the belly rosy, the cheeks of the male white, and the legs flesh-coloured. It is dreaded in Southern Asia on account of the ravages it commits in the rice-fields. It is frequently brought to Europe, and is found in aviaries.

Richard I, King of England, surnamed Cœur de Lion, third son of Henry II by Eleanor of Aquitaine, born at Oxford in 1157, died in 1199. On Henry's death at Chinon, Richard sailed to England, and was crowned at Westminster (Sept., 1189). The principal events of his reign are connected with the third Crusade, in which he took part, uniting his forces with those of Philip of France. In the course of this Crusade he married in Cyprus the Princess Berengaria of Navarre. Richard left Palestine in 1192 and sailed for the Adriatic, but was wrecked near Aquileia. On his way home through Germany he was seized by the Duke of Austria, whom he had offended in Palestine, and was given up a prisoner to the Emperor Henry VI. During his captivity his brother John headed an insurrection, which was suppressed by Richard when he returned to England in 1194. Richard then passed over to Normandy, and spent the rest of his life there in warfare of no decisive character. He died of a wound received whilst besieging the castle of Châlus. Richard was utterly neglectful of his duties as a king, and owes his fame chiefly to his personal bravery.

Richard II, King of England, son of Edward the Black Prince, and grandson of Edward III, was born at Bordeaux in 1367, died in 1400. He succeeded Edward III in 1377. In 1381 took place the insurrection headed by Wat Tyler, in the suppression of which the boy-king showed considerable capacity and boldness, but his after life did not correspond with this early promise. In his sixteenth year (1382) he married Anne, daughter of the Emperor Charles IV. Wars with France and Scotland, and the ambitious intrigues of the Duke of Lancaster, one of his uncles, followed. The proper government of the kingdom

was interfered with by contests for power between the king with his favourites, and his uncle, the Duke of Gloucester, backed by the Parliament. In 1389 the king dismissed Gloucester and his adherents from his council, and took the reins of government himself. In 1394 Anne of Bohemia died, and two years later Richard married Isabella of France. This union was strongly opposed by the Duke of Gloucester, who, in consequence, was suffocated in Calais, where he had been sent for safe custody. A quarrel having broken out between Richard's cousin, the Duke of Hereford, son of John of Gaunt, and the Duke of Norfolk, Richard banished them both. The next year, 1399, the Duke of Lancaster died, and Richard confiscated his estates. This unjust act was the immediate cause of the king's fall. During his absence in Ireland, Bolingbroke, as the Duke of Hereford was called, landed in Yorkshire with a small force, and the king on his return to England was solemnly deposed by Parliament, 30th Sept., 1399, and the crown was awarded to Henry. Richard was imprisoned in the castle of Pomfret, where he is supposed to have been murdered.—**BIBLIOGRAPHY:** Sir J. H. Ramsay, *The Reigns of Edward II, Edward III, and Richard II*; Sir C. W. C. Oman, *Political History of England*.

Richard III, King of England, the last of the Plantagenet kings, born at Fotheringhay Castle in 1452, died in 1485. He was the youngest son of Richard, Duke of York, who was killed at Wakefield. On the accession of his brother, Edward IV, he was created Duke of Gloucester, and during the early part of Edward's reign served him with great courage and fidelity. He married in 1473 Anne Neville, joint-heiress of the Earl of Warwick, whose other daughter was united to the Duke of Clarence, and quarrels arose between the two brothers over their wives' inheritance. On the death of Edward in 1483 the Duke of Gloucester was appointed protector of the kingdom; and he immediately caused his nephew, the young Edward V, to be declared king, and took an oath of fealty to him. But Richard soon began to pursue his own ambitious schemes. Earl Rivers, the queen's brother, and Sir R. Grey, a son by her first husband, were arrested and beheaded at Pomfret, and Lord Hastings, who adhered to his young sovereign, was executed without trial in the Tower. It was now asserted that the king and his brother were illegitimate, and that Richard had a legal title to the crown. The Duke of Buckingham supported Richard, and a body of peers and citizens having offered him the crown in the name of the nation he accepted it, and on 6th July, 1483, was crowned at Westminster. The deposed king and his brother were, according to general belief, smothered in the Tower of London by order of their uncle. (See *Edward V.*) Richard governed

with vigour and ability, but was not generally popular, and in 1485 Henry, Earl of Richmond, head of the House of Lancaster, landed with a small army at Milford Haven. Richard met him on 22nd Aug. with an army of 15,000 men at Bosworth, in Leicestershire. Richmond's force was smaller, but Lord Stanley and Sir William Stanley went over to him and enabled him to win a decisive victory. Richard wore his crown on the field, and fell fighting. His body was subjected to indignities and afterwards buried in Leicester. Richard possessed courage as well as capacity; but his conduct showed cruelty, dissimulation, treachery, and ambition. He has been represented as of small stature, deformed, and of a forbidding aspect; but his personal defects have probably been magnified.—Cf. James Gairdner, *Life and Reign of Richard III.*

Richard, Earl of Cornwall and Emperor of Germany between 1256 and 1272, during the so-called interregnum, a son of King John of England, was born in 1209, died in 1272. In 1256 he was chosen Emperor of Germany by a faction, and was crowned King of the Romans at Aix-la-Chapelle in 1257, but was unable to obtain general recognition.

Richard of Cirencester, or Ricardus Corinensis, an early English chronicler, sometimes called the Monk of Westminster, born about 1335, died 1400. He is the author of a Latin history of England to the year 1066.

Richardson, Samuel, English novelist, was born in 1689, and died in 1761. His father was a joiner who left London after the failure of Monmouth's rebellion, in which he was suspected of having been implicated. Richardson was one of nine children, and was originally intended for the Church. His father, however, was not able to send him to a good school or to the university. The tradition that he was at Christ's Hospital is unsupported by evidence. He remained in the country until he was about thirteen. Even at that age he preferred the society of women to that of boys, and composed love-letters for those of his lady friends who had no talent for that species of composition. Before he was eleven years old he gave a taste of his qualities as a moralist by writing a letter to a widow nearly forty years his senior on the sin of talking scandal. In 1706, being unable to go to the university, he compromised with his love of books by binding himself apprentice to a stationer. His career resembled that of the Industrious Apprentice, though he did not, as some biographies say, marry his master's daughter according to programme; his wife was the daughter of another man of the same name. He worked as a compositor and corrector of the press, and set up business as a printer on his own account in 1719. He printed twenty-six

volumes of the *Journals* of the House of Commons, as well as the *Daily Journal* and the *Daily Gazetteer*. He prospered exceedingly, and eventually became Master of the Stationers' Company (1754) and Law Printer to the King (1760).

During all his career as a printer he had done a certain amount of journey-work, such as making up indexes and writing dedications; he was fifty years old before he commenced novelist. In 1739 two booksellers, Rivington and Osborne, asked him to write a volume of letters which would serve rustic or uneducated readers as a complete guide to the art of letter-writing. *Pamela, or Virtue Rewarded* (1740) was the result, it being a story, in the form of a series of letters, intended "to cultivate the principles of virtue and religion in the minds of the youth of both sexes". This it did by recounting the story of a servant-girl who turned her mistress's son from a would-be seducer to a devoted husband by means of much patient perseverance. Crude as this story seems to sophisticated readers of modern novels, it exactly hit the taste of the period and achieved a great success. It was a story of real life—of low life indeed it might be called—and so presented a welcome contrast to the frothy and impossible romances which had been in vogue. Also, there could be no question at all about its absolute propriety. *Pamela* was the forerunner of a long series of novels and novelettes dealing with the virtues of the poor and the vices of the rich—a theme which drew from Lord Toller the indignant protest that

Hearts just as pure and fair
May beat in Belgrave Square
As in the lowly air
Of Seven Dials.

One of the immediate consequences of this novel was the publication of several skits upon it, by far the most illustrious being Fielding's *Joseph Andrews* (1742), which was originally intended as a burlesque, but which became a novel of life and manners (see *Fielding*). Richardson's own sequel to *Pamela* was, like most sequels, of little merit.

His second novel, *Clarissa, or the History of a Young Lady*, was published in seven volumes between Nov., 1747, and Dec., 1748. This mode of publication undoubtedly increased the interest aroused by the book, which is, however, its author's masterpiece. Its fame spread all over the Continent, and it is interesting to note that the Abbé Prévost had to make in his translation certain omissions to suit the delicacy of French taste. *Clarissa*, which is also written in the form of letters, was intended as a companion-piece to *Pamela*, and was designed to show that virtue was not invariably rewarded. The chief

fault of this novel is its inordinate length. It is far more mature than *Pamela*, and shows a deeper knowledge of the human heart. It reduced all Europe to tears, and had a great effect upon Continental fiction.

Richardson's third and last novel, *The History of Sir Charles Grandison*, was published in 1753. He intended to call it *The Good Man*, but probably decided on second thoughts that such a name would decrease the sale of the book. Sir Charles is as great a prig as Tennyson's King Arthur, and is equally "tolerable and not to be endured". But the book has many good qualities, and is in a few respects a riper book than *Clarissa*.

Antagonistic as Fielding and Richardson were, there are many points of resemblance in their work and development. They both wrote three novels; the first in both cases is immature, and became a novel by a kind of accident; the second in both cases is the masterpiece; and the third in both cases marks a decline, but is better than the first. It has been unkindly said of Richardson that he was familiar with the workings of the female heart because he was something of an old woman himself. His sensitive and timid nature shrank from the coarseness of the men of his day. He has little in common with fox-hunting, port-drinking Harry Fielding. He preferred female society, and surrounded himself, especially in his old age, with a Chorus of Rapturous Maidens. His knowledge of women is profound, but he attained it by patient research rather than by flashes of inspiration. To the present age he is unendurably prolix, but his good qualities and his wide influence are undeniable. The idea of writing a novel in the form of a series of letters became very popular; Smollett's masterpiece, *The Expedition of Humphry Clinker* (1771), and Miss Burney's *Evclina* (1778) are good examples. Jane Austen began to draft *Sense and Sensibility* in this form. Richardson has been more appreciated in Germany and France than in Britain, partly because his psychology is good and his description of English manners not so good, so that a foreigner would see his strong points and be unaware of his weak ones. His influence is to be seen in the work of such men as Lessing, Schiller, Rousseau, and Voltaire, and is even more conspicuous in the stories of the greatest of all French novelists. Balzac, in his passion for minutiae and in his elaborate dissection of the human heart, shows himself clearly to be a disciple of Richardson. — BIBLIOGRAPHY: A. Dobson, *Samuel Richardson* (English Men of Letters Series); *Eighteenth Century Vignettes* (Second Series); C. L. Thomson, *Samuel Richardson: a Biographical and Critical Study*.

Richborough, a port of Kent, England, near Sandwich, on the left bank of the mouth of the Stour River. There are remains of a Roman fort or castle, said to have been built by Severus. During the Roman occupation of England, Richborough, known as *Rutupia*, and its port, *Portus Rutupensis*, were the principal places of entry. British, Roman, and Saxon coins have been found in abundance.

During the European War (June, 1916) it was found necessary to find a port as near as possible to the canal outlets of Northern France. It was essential, however, that it should not already be overburdened with transport work, and that it should be within easy reach of some central main railway system, to ensure the quick transit of products from munition and other factories to canal- and rail-heads of French and Flemish ports. Land was acquired at the mouth of the Stour (Pegwell Bay), and by Dec., 1916, the new port of Richborough was at work, and performed valuable services throughout the war.

Richelieu (rêsh-lyeu), Armand Jean du Plessis, Cardinal, Duc de, French statesman, born at Paris 9th Sept., 1585, died there 4th Dec., 1642. He was the son of François Duplessis, Seigneur de Richelieu in Touraine, and was originally destined for the army; but his brother Alphonse having resigned the bishopric of Luçon, this was bestowed on him by Henri IV (1606). He obtained from the Pope a dispensation allowing him to accept the office though under age, and in 1607 was consecrated by the Cardinal de Givry in presence of the Pope himself (Paul V). In 1614 he came to Paris, insinuated himself into the favour of the queen-mother, Marie de Medici, who obtained for him the post of Grand Almoner, and in 1616 that of Secretary of State for War and Foreign Affairs. Through the influence of the queen-mother he obtained the cardinal's hat, and in 1624 was admitted into the Council of State. From this date he was at the head of affairs, and he at once began systematically to extend the power of the Crown by crushing the Huguenots, and overthrowing the privileges of the great vassals; and to increase the influence of the French monarchy by undermining that of the Habsburgs, both beyond the Pyrenees and in Germany. In order to overthrow the power of the great nobles he ordered the demolition of all feudal fortresses which could not be used for the defence of the frontiers. After the suppression of the Huguenots his next step was the removal of the queen-mother from court, she having endeavoured to effect his fall. This he accomplished in Nov., 1630. But this step, and the almost total annihilation of the privileges of the Parliaments and the clergy, united all classes against the despotism of the cardinal, and several

risings and conspiracies took place, which were suppressed by prudent and vigorous measures. In 1631 Richelieu was raised to the rank of duke. The whole period of Richelieu's government was marked by a series of conspiracies of the feudal nobility, the queen-mother, the queen herself, and even Louis, against the royal power exercised by Richelieu. But he was prepared at every point and his vengeance sure. During the Thirty Years' War the cardinal employed all the arts of negotiation and even force of arms to protect the Protestants of Germany, for the purpose of humbling the power of Austria. For the same object he declared war against Spain in 1635, and the separation of Portugal from Spain was effected by his assistance (1640). He also endeavoured to weaken Austrian influence in Italy, and procured the transfer of the Duchy of Mantua to the Duke of Nevers. Among the last to be crushed by him were Cinq-Mars and De Thou, who, with the king's approval, attempted to ruin the great minister. Before his death he recommended Cardinal Mazarin as his successor. Richelieu was a great statesman, but he was proud, arrogant, and vindictive. He was a patron of letters and art, and founder of the French Academy and the Jardin des Plantes. The Palais Cardinal, subsequently known as the Palais Royal, was Richelieu's Paris residence. His works include *Mémoires* relating to the years 1624-38, and *Histoire de la mère et du fils*. — BIBLIOGRAPHY: J. B. Perkins, *Richelieu and the Growth of the French Power*; G. d'Avenel, *Richelieu et la monarchie absolue*; G. Hanotaux, *Histoire du Cardinal de Richelieu*.

Richmond, an ancient municipal borough of England, in the county of York (North Riding), on the left bank of the Swale; served by the North-Eastern Railway. The castle, comprising an area of nearly 6 acres, is one of the most majestic ruins in England. Pop. 3883.

Richmond, a municipal borough of England, in the county of Surrey, a residential suburb of London, partly on an acclivity of Richmond Hill, and partly on a plain along the Thames. There are railway (London & South-Western), tram, tube, and 'bus connections. It is a favourite resort of Londoners for boating and other recreations, the scenery in the vicinity being very beautiful, and the view from Richmond Hill one of the finest river views to be obtained anywhere. Richmond was a favourite residence for many centuries of the monarchs of England, several of whom died there. The great park of Richmond, formed by Charles I, is enclosed by a brick wall 8 miles in length. Pop. of municipal borough, 35,651.

Richmond, a city and port of entry of the United States, the capital, the largest city, and the principal manufacturing centre of Virginia,

and county seat of Henrico county, at head of seagoing navigation on the James River; served by the Atlantic Coast, Seaboard Air Line, and other railways, and by ocean-going steamships. There are many fine buildings of historic interest. The State House or Capitol (begun 1785) contains Houdon's marble statue of Washington (1796). The Virginia Union University was founded in 1865; it is reserved for negroes. Water-power is almost unlimited, and the various mills and factories give employment to numerous workmen. The principal manufactures are tobacco, machinery, iron and steel, wooden and leather goods, and coffee.

There were English settlers at Richmond in 1609; the city was formally founded in 1737, and became the seat of State government in 1779. During the Civil War it was the seat of the Confederate Government, and the Tredegar ironworks of Richmond was the Confederate cannon-founding centre and arsenal. After a siege it was entered by the Federal armies on 3rd April, 1865. Pop. (1920), 171,670.

Richter, Jean Paul Friedrich, commonly called *Jean Paul*, German writer, born 21st March, 1763, at Wunsiedel, in the Fichtelgebirge, died 14th Nov., 1825, at Baireuth. In 1781 Richter entered the University of Leipzig in order to study theology, but soon changed his plan, and devoted himself to literature. In 1784 he was forced by poverty to leave Leipzig. From 1787 to 1794 he was a private tutor, but in the meantime he had published his *Grönlandische Prozesse* (Greenland Lawsuits, 1783-4), *Auswahl aus des Teufels Papieren* (Selection from the Devil's Papers, 1789), and *Die unsichtbare Loge* (The Invisible Lodge, 1793). This brought him fame and money, and was followed by another romance, *Hesperus* (1795), and *The Life of Quintus Fixlein* (1796), a humorous idyll, works which made his name one of the best known in Germany. Jean Paul (this was the name under which Richter wrote) is a humorous writer, but his humour is of a peculiar kind, being deeply reflective and philosophic. Many passages in Jean Paul's works are poetry in prose form. His works are generally in the form of novels, but they have little of the character of the ordinary novel. He seems to have liked particularly to analyse emotions, and to dissect individual character in every station, even the humblest. His writings, other than those noted above, include: *Blumen-, Frucht-, und Dornenstücke* (Flower, Fruit, and Thorn Pieces, 1796), *Der Jubelseniör* (Parson in Jubilee, 1797), *Das Kampaner Thal* (1797), *Titan* (1800), *Flügeljahre* (translated by Carlyle 'Wild Oats', 1804). — BIBLIOGRAPHY: F. J. Schneider, *Jean Pauls Jugend*; P. Nerrlich, *Jean Paul, sein Leben und seine Werke*; Thomas Carlyle, *Miscellaneous Essays*.

Ric'imer, a general of barbarian descent who ruled the western Roman Empire by emperors whom he set up and put down at will. He dethroned Avitus in 456, and appointed Majorianus emperor, whom he caused to be assassinated in 461. He then placed Livius Severus on the throne, and on his death in 465 he carried on the government for some time alone. In 467 Anthemius was put on the throne, and gave his daughter in marriage to Ricimer. The latter soon took up arms against his father-in-law, who was assassinated in 472. Ricimer died soon after.

Rickets, a disease peculiar to infancy, chiefly characterized by changes in the texture, chemical composition, and outward form of the bony skeleton, and by altered functions of the other organs, transient for the most part, but occasionally permanent. The chief external features are the legs bent outward, chest unduly projecting, head large and forehead projecting, spine often curved, joints large and prominent, and general form stunted. As a cause of death among infants, rickets is much less serious than it was at one time. It is chiefly a disease of large cities, and its development is favoured by want of nourishing food, overcrowding, and neglect of sanitary and hygienic precautions generally. There is good ground for believing that rickets is due to the absence of a certain vitamin, commonly found in fats, such as butter and cod-liver oil, and also in fresh vegetables. In the treatment, all means are employed by which the system is invigorated, including good food, fresh air, and exercise. The use of splints for the legs is often beneficial.

Ridings. The large extent of the county of York is due to historical causes. It represents a Danish kingdom which was not completely subdued before the Norman Conquest, and the local nomenclature of Hallamshire, Richmondshire, Cleveland, &c., may represent abortive attempts at shire formations. The existing division into Ridings, i.e. Thirdings, is as old as *Domesday Book*. See *Yorkshire*.

Ridley, Nicholas, Bishop of London, born about 1500, died 1555. Educated at Cambridge, he travelled on the Continent for three years, and on his return filled the office of proctor at Cambridge University. In 1547 he was chosen to the see of Rochester, and in 1550 superseded Bonner as Bishop of London. On the death of Edward VI he was involved in an attempt to secure the Protestant ascendancy by placing the Lady Jane Grey upon the throne. This, together with his connection with Cranmer, led to his being tried for heresy, and after a formal disputation on the controverted points with a deputation of Roman Catholic bishops he was condemned to the stake. This sentence he

underwent with the greatest fortitude, in company with his friend and fellow-sufferer Latimer.

Riemann, Georg Friedrich Bernhard, one of the greatest mathematicians of the nineteenth century, was born in Hanover in 1826, and died in 1866. He studied at Göttingen and Berlin, became extraordinary professor at Göttingen in 1857, and full professor, in succession to Dirichlet, in 1859. His chief work was done in the theory of functions of a complex variable, and especially in the theory of algebraic functions; but he is best known for his epoch-making discoveries in non-Euclidean geometry (q.v.).

Rien'zi, Cola di, a native of Rome, born about 1312, died 1354. He was the son of a tavern keeper, acquired a good education, and early distinguished himself by his talents, and especially by his attacks on the tyranny of the nobles. In 1342 he endeavoured to induce Pope Clement VI, then at Avignon, to initiate reforms, but nothing was done. In 1347, during the absence of the Governor of Rome, Stefano Colonna, Rienzi summoned a secret assembly of his friends upon Mount Aventine, and induced them all to subscribe an oath for the establishment of a plan of government which he called the *good estate*. The people conferred upon him the title of tribune, with all the attributes of sovereignty. He banished several noble families, and compelled Colonna to quit Rome. His strict regard to justice and the public good in the first exercise of his power induced even the Pope to countenance him. But he subsequently became ambitious and haughty, and finding he had lost the confidence of the people he withdrew from Rome in 1348. He returned secretly to Rome in 1350, but was discovered, and fell into the hands of Pope Clement at Avignon, who imprisoned him for three years. Innocent VI released Rienzi, and sent him to Rome to oppose another popular demagogue named Boroncelli. After a turbulent administration of a few months he was killed in a riot. Rienzi is the central figure of Bulwer Lytton's romance *Rienzi, the last of the Roman Tribunes*, upon which Wagner's opera is based.—Cf. F. Gregorovius, *History of the City of Rome in the Middle Ages*.

Riesa (rě'zà), a river-port and railway junction of Saxony, on the Elbe. It has a large river export trade. Pop. 15,200.

Riesengebirge (rě'zen - gè - birgè; Giants' Mountains), a mountain range of Europe, separating Silesia from Bohemia and Moravia, till it joins the Carpathians; but the name is properly applied to that part of this range which lies between the sources of the Neisse and the Bober.

Riesi (rě-ā'sè), a town of Sicily, in the province of Caltanissetta. It has large sulphur-mines, and the olive and vine are extensively cultivated. Pop. 15,000.

Rieti (rē-ā'tē; ancient Reate), a city of Italy, in the province of Perugia, on the Velino. It is the see of a bishop, and has an imposing cathedral (1456). The manufactures include silk and woollen stuffs. Pop. 14,000.

Rif, The, the eastern half of the Spanish Zone of Morocco, lying on the shores of the Mediterranean, and bounded on the east by the Muluya, west by the Uringa, and by the Beni-bu-Yahi and Beni Hassan Mountains on the south. Area, about 800 sq. miles.

Physiography.—Running parallel to the Mediterranean, and extending into the hinterland in concentric chains, rise the crescent-shaped mountains of the Rif, merging with the Jebala range at their western extremity. All the peaks, which include Jebal Mezgut de Guiliz and Jebal Arzú, are under 7000 feet altitude. The Muluya is the principal river of the Rif, and the fifth of Morocco.¹

People.—Physically, the Rifi are a magnificent race. Tall and well proportioned, they are of commanding appearance, and are not only mountaineers of repute and renowned riflemen, but they are also the finest of all Moroccan soldiers. Their hardihood and personal worth are undoubted, but collectively they are exceedingly treacherous. The modern Andjerines, who inhabit the promontory occupied in part by the Spanish fortress-town of Ceuta, were the Barbary pirates of bygone times, and the Rifi in general are admittedly wreckers when opportunity occurs. They have been suspected also of a leaning towards piracy even in modern times. The Rif was never an integral part of the Moroccan Empire, and the patriarchal system is, and has been, the foundation of Rifian political and social life. In general there are no permanent rulers, and a *Jemaa* or popular assembly is supreme. Although they are classed as Arabicized Berbers, and have indeed European features and colour under the deep tanning effected by the sun, the Rifi have little or no Arabic, and the aboriginal Berber Kball has come down as a language entirely devoid of exotic features. Tradition has it that Mahommedanism and the *Koran* were imposed upon the Rifi by Mussulman invaders on twelve different occasions, and this at the point of the sword; but the modern Rifian cares little for Koranic precept except in so far as a large number of wives, and their work, or the sale of daughters got by them, may increase the material wealth of the individual tribesman. For the Rif the rifle is all-powerful, and even family quarrels are submitted to the arbitrament of the sword. The customary garb of the tribes-

man comprises cotton undergarments (from Manchester), a cloth waistcoat (from Roubaix), and a cloak or *jellaba* of native manufacture. Enormous home-made straw hats are also worn.

Towns.—The Rifian houses are dry-stone built from small angular stones. There are no native towns, the largest villages containing only 2000 or 3000 inhabitants, while the nomadic peoples of the eastern plateaux live in tents. The only towns, therefore, are Spanish possessions; they are, Melilla, Alhucemas, and Penon de Velez.

Production.—There is no agriculture other than such individual cultivation as may be necessary for family supplies, and the Rifi have no manufactures of economic importance. They are, however, ready buyers of tea, sugar, cloth, rifles, and ammunition. An important feature of the Rif is its proved mineral wealth. Iron ore (hematite), copper, lead, silver, antimony, zinc, and silver are found, and some exceedingly valuable lead- and silver-mines are being worked by Spain. See *Morocco*; *Melilla*.

Rifle, a fire-arm of which the inside of the barrel or bore is grooved in such a way as to impart a rotary motion to the projectile fired from it. This is known as rifling, and may be likened to the arrangement by which a metal slot designed to receive a steel screw has a groove cut round it in which the thread of the screw engages. In the case of the rifle and bullet the bore only is grooved, and the comparatively soft metal of the bullet is forced by the explosion of the charge to take the grooves and assume a screwing or rotary motion. On leaving the barrel the result of this rotary motion is that the elongated projectile now universally used is kept point foremost, and consequently offers a comparatively small surface to the resistance of the air. As the projectile continues to rotate on its longer axis for as long as the effect of the initial explosion of the charge continues, so any inequality on the surface of the projectile, instead of being always on one side and causing deflection, is presented to the air on all sides in turn, thus negating the inequality and tending to accuracy of flight. The rifling of a barrel may be said to answer the same purpose as the feathers on the butt of an arrow; without feathers the arrow would be liable to turn over in its flight; with feathers it keeps its course till its energy is exhausted. Similarly, an elongated bullet fired from a smooth bore would on leaving the muzzle quickly turn over and over instead of boring its way screw fashion through the air.

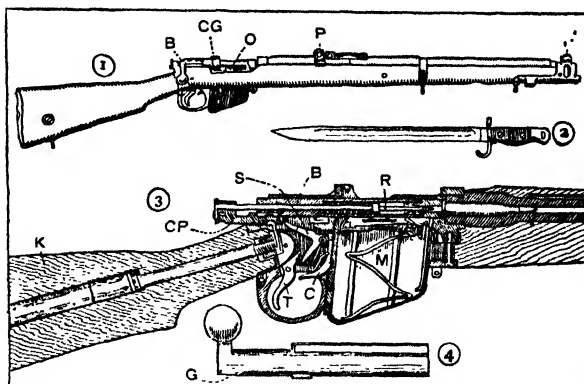
Properly speaking, the word rifle can be applied to a fire-arm of any calibre of which the bore is grooved; in practice the word is used to describe a 'hand-gun' designed to be fired from the shoulder, and for the personal use of one man either as a soldier or a hunter of big game. The

¹ In order of importance the Moroccan rivers are: (1) Sebú, (2) Um-er-Rbia, (3) Bu-Regreg, (4) Tensift, (5) Muluya, (6) Warga, and (7) Kert. None of these is navigable, and the numerous lesser streams are merely of use as landmarks and for irrigation purposes.

adjective 'rifled' is always used in connexion with modern cannon.

Rifles, both military and sporting, are, as a practical proposition, of comparatively modern date, though many attempts were made in the days of muzzle-loaders and spherical balls to apply the system of grooving the bore, and thus to obtain in some measure the steady motion of the arrow. A far more important consideration, seeing that the elongated bullet was still unknown, would seem to have been the desire to abolish the wastage in power caused by the necessary difference between the size of the spherical ball and the bore of the piece. This difficulty, which was unavoidable when the bullet had to be rammed home from the muzzle, as was the case with the guns of the period, was never satisfactorily overcome till the introduction of the breech-loading principle. This difference in size of bore and bullet allowed a large proportion of the gases generated by the explosion to escape round the ball during its passage up the barrel, and it was hoped to avoid this by causing it to take the grooves. Two main methods were used to obtain this end, the one by so constructing the bullet that it would expand when the charge was exploded and so force itself into the groove, the other by fitting the bullet with a belt to fit the grooves from the moment of loading. It is known that as far back as the sixteenth century, and even earlier, the Continental gunmakers—Gaspard Kollner of Vienna among them—were experimenting with the grooving system, and, apparently, with some little success, for Fremantle in his *Book of the Rifle* says that some Danish troops were armed with a rifle in 1611, and that Louis XIII of France had a carabinier regiment of cavalry entirely armed with rifled carbines; but, probably owing to the length of time required to load, and the physical difficulty of ramming the ball home, rifles seem to have fallen into disrepute in France, and, by the end of the eighteenth century, to have been replaced by smooth-bore muskets. In England, and for the same reason, they do not seem to have been considered as suitable arms for regular infantry, and it was not till 1800 that any attempt was made to arm these troops with them. The volunteers, who flourished during the Napoleonic scare in the

first decade of the nineteenth century, took a different line, and H. J. Blanch in his book *A Century of Guns* says that many of the corps then in existence armed themselves with rifles instead of muskets, while Fremantle reproduces a contemporary print of a 'rifle-match' between



Short Magazine Lee-Enfield Mark III

1. General view. 2. Sword bayonet. 3. Longitudinal section showing rifle at full cock. Last cartridge in chamber. 4. The bolt.

The Lee-Enfield is a bolt-action magazine-rifle of the semi-automatic type, i.e. the mechanism employed for recocking after discharge, ejecting the discharged cartridge-case, and transferring a loaded cartridge from the magazine to the chamber, is operated by hand and not by the recoil or gas pressure of the weapon, as in the case of fully automatic fire-arms.

The 'action' or operating mechanism of this rifle consists of three principal parts: (1) the bolt (B), containing the spring-operated striker (R) rigidly attached to the cocking-piece (CP); (2) the trigger (T), with sear (S) controlling the action of the striker; and (3) the magazine (M), which when full contains ten cartridges.

In order to load, the bolt (B) is drawn back to the full extent, bringing the charger guide (CG) on the bolt head into position to receive the charger. A charger containing five cartridges is placed between the guides, and the cartridges are forced into the magazine by the thumb. When the bolt is pushed forward, the charger is forced out, and the striker retained in a stationary position by the cocking-piece engaged on the nose of the sear. By this action the mainspring is compressed. As the bolt moves forward, the lower part of the bolt head engages behind the top cartridge in the magazine, and forces it into the chamber.

Pressure on the trigger (T) now releases the cocking-piece by disengaging the sear (S), and the striker is forced by the action of the mainspring on to the cap of the cartridge.

On drawing back the bolt after firing, the extractor on the bolt head engages on the rim of the empty cartridge-case and draws it back till it comes into contact with the ejector screw, which forcibly ejects it. The magazine spring then pushes another cartridge into position to be carried forward by the bolt on its return journey. The magazine is provided with a cut-off which, when closed, enables the rifle to be used as a single loader. A safety catch is provided, by which the whole mechanism can be securely locked so that the rifle may be carried loaded with perfect safety.

P, Backsight protector. P', Foresight protector. C, Magazine catch. G, Bolt cam grooves. K, Stock. O, Cut-off.

the 'Duke of Cumberland's Sharpshooters' and the 'Robin Hood Rifles', which took place in 1811. At this period and for a good many years after, the regular army with one exception was armed entirely with the 'Brown Bess' musket, firing a round ball of fourteen to the pound. During the last quarter of the eighteenth century attention had been drawn to the possibilities of the rifle by the performances of the colonists in the American War of Independence. A

Colonel Fergusson had designed a rifle in 1776 with an elementary form of breech consisting of a vertical hole in the barrel closed by a screw, and at an exhaustive test carried out that year his rifle, according to Blanch, appears to have acquitted itself well. But for some reason—possibly because the inventor was killed two years later—nothing more seems to have been done till, in 1800, the 95th (Rifle Brigade), then in process of formation, was armed throughout with the newly invented 'Baker' rifle. This was a muzzle-loading flint-lock weapon with a 2 feet 6 inch barrel, seven grooves, a weight of 9½ lb., and firing a ball of which twenty went to the pound, i.e. of .615-inch calibre. Very considerable force was required to drive the ball home. This rifle remained in use as the arm of the Rifle Brigade till 1837, when it was replaced by the 'Brunswick' rifle, which was planned on the percussion principle invented in the meanwhile by Forsyth. The weight of this weapon was 11 lb. 6 oz.; length of barrel, 2 feet 6 inches; calibre, .704 inch; and sighting for 800 yards was provided. It had only two grooves, which were continued to the outside of the muzzle, forming two notches. The bullet had a raised belt round its circumference, and at the moment of loading this belt was fitted into the two notches and then rammed home. This rifle was not a success, but it remained the arm of the Rifle Brigade till 1850 or thereabouts, when the 'Minié' rifle, the invention of a French officer of that name, was issued to rifles and infantry of the line alike.

The Minié was very quickly superseded by a rifle of British design and manufacture—the 'Enfield' of .577-inch calibre and 9 lb. 9 oz. in weight. The bore had three grooves making a half-turn in the length of the barrel, and the bullet was a conical one with a hollow base. The Enfield continued to be the arm of the British infantry till 1867, when, a satisfactory breech-block system having been found, it was converted into a breech-loader and known as the 'Snider', after its inventor. Both these weapons, the muzzle-loader and the breech-loader, were excellent weapons of their time, but the latter was only a makeshift to tide over a period of change, and in 1869 was replaced by the .450 'Martini-Henry', a rifle with a falling block action, and of very durable and simple construction. This rifle held the field for nearly twenty years, after which it was replaced by the 'Lee-Metford', a bolt-action small-bore (.303) rifle adapted for either single or magazine loading. From this, after various alterations and additions made in the light of modern knowledge, has been evolved the rifle of the present day, known as the 'short magazine Lee-Enfield'. This rifle has an improved bolt and other features, and is shorter and lighter and consequently more handy than

its original. It is loaded entirely by means of 'chargers' containing five cartridges each; the magazine, which is removable, holds ten cartridges.

Weight of rifle ..	8 lb. 14½ oz.
Length ..	3 feet 8½ inches.
Calibre ..	.303.
Rifling ..	Enfield: five grooves, making one left-handed turn in 10 inches.

Muzzle velocity according to the ammunition used up to 2440 feet-seconds. The main sighting system allows for any range up to 2000 yards, and a supplementary arrangement for a further 800 yards is provided.

For sporting purposes both magazine and double-barrelled rifles are used, the former being invariably small bore, i.e. .303, .256, &c., while the latter are usually of heavier pattern and slightly larger bore, firing a high-velocity cartridge; these rifles are known as 'Express' rifles, being meant to be used only at comparatively short range and to give a low trajectory. The new high-velocity Expresses have replaced the old rifles of .450, .500, or .577 calibre, which were the usual sporting rifles round about 1900, and a modern Express rifle of .400 has almost as much hitting power as had the old eight- or four-bore rifle.

RIFLES OF SOME FOREIGN NATIONS

Country.	Name of Rifle.	Calibre.	Loading System.
Austria ..	Mannlicher	.315	Clip of 5 cartridges.
Belgium ..	Mausier	.301	Charger of 5 cartridges.
France ..	Lebel	.315	Tube fore-end.
Germany ..	Mausier	.311	Charger of 5 cartridges.
Italy ..	Mannlicher	.256	Clip of 6 cartridges.
Norway ..	Krag-Jorgensen	.256	Charger of 5 cartridges.
Serbia ..	Mausier	.276	Charger of 5 cartridges.
U.S.A. ..	Springfield	.3	Charger of 5 cartridges.

Rifle Regiments, originally light infantry regiments armed with rifles, as distinct from the muskets which were the arms of regiments of the line. In these days the distinction is merely a matter of tradition, the training and arms of all troops being the same, though 'Rifles' use the 'trail arms' instead of the 'slope'. In 1800, when the Rifle Brigade was first raised by Colonel Coote Manningham by drafts from various line regiments, the difference was very real, and a letter to the commanding officers of the regiments selected to provide drafts contains the words "for the purpose of being instructed in the use of the rifle and in the system of exercise adopted by soldiers so armed".

Rifle regiments in the British service are: The Cameronians (Scottish Rifles), The King's Royal Rifle Corps, The Royal Ulster Rifles (late The Royal Irish Rifles), and The Rifle Brigade. The uniform of Rifle regiments is green, with facings of black, red, or dark-green.

Rifle Shooting. The National Rifle Association was founded in 1860 "for the encourage-

ment of rifle corps and the promotion of rifle shooting throughout Great Britain . . . as a national pastime to make the rifle what the bow was in the days of the Plantagenets, the familiar weapon of those who stand forth in the defence of their country". A shooting-range was established at Wimbledon, and there, in 1860, the Association's first shot was fired by Queen Victoria from a Whitworth rifle placed on a machine rest, a bull's-eye being scored at a range of 400 yards. The Whitworth, a muzzle-loader, continued for the next ten years to be employed by numerous prize-winners. The Dreyse breech-loading needle-gun had been adopted by the Prussian army as early as 1848, but breech-loaders did not come into general use among British marksmen until nearly twenty years later. In succession to the Whitworth rifle the Metford shallow-rifled weapon was employed; and in 1870 the Duke of Cambridge's prize was secured by the user of a Martini-Henry. Five years later an American team visited England, and for the first time took part in the competition, using breech-loaders and adopting the novel 'back' position. In 1890 the Association removed its range to new ground at Bisley, near Woking, which is still in use. The Bisley meeting takes place in July, and attracts competitors—both single marksmen and teams—not only from all parts of Britain, but also from the Channel Islands, India, and the Colonies. The most coveted prize is the Association's gold medal, the winner receiving the King's Prize. Silver and bronze medals are also awarded.

Riga, a Baltic seaport, and capital of Latvia (q.v.). It was formerly the capital of the Russian government of Livonia, and stands on both sides of the Dvina or Dwina, about 5 miles above its mouth in the Gulf of Riga. The river is crossed by a pontoon bridge connecting with the Mitau suburb on the left bank, and by a great railway viaduct which has a railed path along the outside for pedestrians. On both sides of the river are spacious quays. The ancient cathedral, St. Peter's Church, and the Riga Polytechnic, which in 1919 was raised to be the Latvian University, are the principal buildings. There is also a musical academy. Small ships can come up to the town, but vessels of average size unload and take in cargo at Dvinsk (Dünamünde), the port and fortress at the mouth of the river. Riga was an important industrial, commercial, and shipping centre before the European War, and had then a population of half a million, reduced (1920) to 185,140. To-day there are neither raw materials, nor capital and credit to purchase them. The whole transport system of Latvia has been reduced to chaos, and the only regularly operated line is that between Riga and Libau. The main hope for Riga is that it may become the meeting-

place of the various representatives of a 'union of Baltic states' (Finland, Esthonia, Latvia, Lithuania, and Poland). On 3rd Sept., 1917, Riga was occupied by German forces. Latvian independence was proclaimed in Nov., 1918, and Riga fell to Bolshevik forces in Jan., 1919, but was evacuated in May and again occupied by the Germans, who were attacked by a combined army of Letts and Esthonians, but held the city until compelled to leave under pressure from the Inter-Allied Commission in the Baltic. For the battles round Riga, see *European War*.

Riga, or **Livonia**, Gulf of, a gulf of the Baltic, washing the coasts of the republics of Latvia and Esthonia. It contracts in the west to a comparatively narrow entrance, and to a still narrower in the north, the Esthonian islands of Ösel, Dagö, &c., almost closing it.

Right of Way, the right of passing over land not one's own. Rights of this kind are public if enjoyed by everybody; private, if enjoyed by a certain person or description of persons. Wherever there is a public right of way, there is a highway. The origin of a highway is generally said to be in a dedication thereof by an owner to the public; and such dedication may be express or implied. It will be implied from the use of the highway by the public for a moderate number of years. But a highway may also be established by Act of Parliament. A private right of way may be acquired by immemorial usage, or by existing for forty years, or by express grant by deed. In Scotland a public right of way is acquired by possession for the prescriptive period of forty years, or from time immemorial.

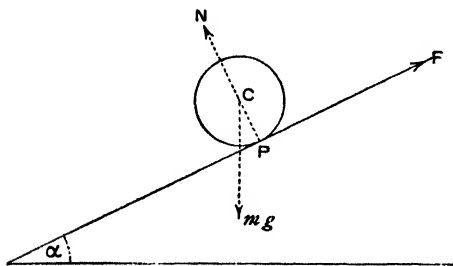
Rights of Man, and of the Citizen (*Déclaration des droits de l'homme et du citoyen*), a term applied to the fundamental rights contained in the famous declaration adopted by the French National Assembly on 26th Aug., 1789, and accepted by Louis XVI on 5th Oct., 1789. Attacked by Burke in his *Reflections on the French Revolution*—wherein he styled it as anarchy—it was defended by Thomas Paine in his *Rights of Man*.

Rigi (rē'gē), an isolated rocky mountain of Switzerland, in the canton of Schwyz, between Lakes Zug and Lucerne, 5905 feet high. It affords some of the finest views in Switzerland, and is annually visited by numerous travellers. Two railways have been constructed to reach its summit (Rigi-Kulm) from opposite sides. They are on the 'rack-and-pinion' principle, there being a central toothed rail into which works a toothed wheel under the locomotive. There is also a short line on the mountain worked on the ordinary principle.

Rigid Dynamics is more correctly called *The Dynamics of Rigid Bodies*. A rigid body is one in which the distance between each pair of its

particles is unalterable. No natural body is perfectly rigid, but the theory based on the concept of an absolutely rigid body is applicable without important error to many investigations upon the motion of actual bodies. The theory applies exactly, not merely to absolutely rigid bodies, but to all those which, under given conditions, remain unaltered in size and shape. The present article contains one or two examples of the principles explained under the heading *Kinetics*.

Consider the motion of a uniform sphere rolling down a rough inclined plane under gravity. The forces acting on the sphere are:



(1) the weight of the sphere, mg , acting at its centre C ; (2) the normal reaction N of the plane, and (3) the friction F , both acting at P , the point of contact. Resolving normally to the plane, since there is no acceleration of C in that direction, $N - mg \cos \alpha = 0$. Resolving down the plane, $mg \sin \alpha - F = m\ddot{x}$, \ddot{x} being the acceleration of C . Since the torque about the axis is Fr , we have $Fr = I\omega' = mk^2\omega'$, writing I in the form mk^2 , the length k being then called the radius of gyration about the axis. Besides these three equations of motion, we have the kinematic relation $\ddot{x} = \omega'$. Eliminating ω' , F , and N we get $mg \sin \alpha = m\ddot{x} + mk^2 \ddot{x}/r^2$, whence $\ddot{x} = Cg \sin \alpha$, where $1/C$ stands for $1 + k^2/r^2$. The values of k^2 for some uniform bodies are: solid sphere, $k^2 = \frac{2}{5}r^2$, $C = \frac{5}{7}$; thin hollow sphere, $k^2 = \frac{2}{3}r^2$, $C = \frac{3}{5}$; solid cylinder, $k^2 = \frac{1}{2}r^2$, $C = \frac{4}{5}$; hollow cylinder, $k^2 = r^2$, $C = \frac{2}{3}$; light hoop, with its mass at its centre, $k^2 = 0$, $C = 1$. Thus in every case except the last, the acceleration is less than $g \sin \alpha$, that of a smooth body sliding down the same inclined plane. By setting bodies of different sorts to roll down a rough inclined board the inequality of their accelerations can easily be observed.

When *impulsive* forces act, it is convenient to calculate total change instead of rate of change of momentum or of moment of momentum. Take the case of a uniform rod AB , of length $12a$, and mass m , lying on a smooth horizontal plane, and struck normally by a horizontal blow of impulse P at a point D distant $8a$ from the end B . It is required to find v , the velocity of C ,

and ω , the angular velocity produced. The equation of motion for the centre of inertia C is $P = mv$; $\therefore v = P/m$, and this velocity is in the direction of the blow. Again, for rotation, we have $P \times 8a = mk^2\omega$, where in this case $k^2 = 12a^2$; $\therefore \omega = P/4am$. If Q be any point in AC , its velocity relative to C will be $\omega.CQ$, perpendicular to AC . Hence if $\omega.CQ = v$, i.e. if $CQ = 4a$, the point Q will be instantaneously at rest. The subsequent motion will consist of a uniform rectilinear motion of C combined with uniform rotation of the rod about C .

The more complicated types of motion of rigid bodies can only be briefly referred to. The case of a body moving freely *under no forces* has been studied deeply by Poincaré, MacCullagh, and others, both geometrically and analytically. Such a body moves so that its centre of inertia has uniform rectilinear motion. The axis through the centre of inertia about which the moment of momentum is a maximum, is fixed in direction, and is called the *invariable line*. When one point is fixed, the instantaneous axis describes a cone in the body, and another cone in space.

Rigsmåal, or **Dano-Norwegian**, to be distinguished from **Landsmaal**, a written language based upon the existing peasant-dialects in Norway. All the classics of Norway and all the Acts of Parliament are written and published in **rigsmåal**, whilst the **landsmaal** is an artificial language not used for social intercourse. See *Asaen*.

Rim'ini (ancient **Ariminum**), a city of North Italy, in the province of Forlì, between the Marecchia and the Ausa, near their mouths in the Adriatic. It has a cathedral, built in the thirteenth century; the church of San Giuliano, with a superb altar-piece by Paul Veronese; the triumphal arch of Augustus, of simple and massive architecture; and the bridge of Augustus over the Marecchia, built of white marble, and still in perfect preservation. Silk manufacture and fishing are carried on. Under the Romans Rimini was the terminus of the Flaminian and Æmilian ways. It fell to the Malatestas in the thirteenth century, was ceded to Venice in 1500, and eventually came into papal possession. Pop. 45,000.

Rimu, a New Zealand tree (*Dacrydium cupressinum*) of the yew family. It grows to a height of 80 to 100 feet, and from 2 to 6 feet in diameter. Its wood is valued for general building purposes.

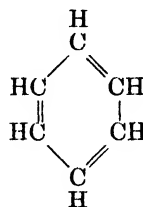
Rinderpest (German name), or **Cattle-plague**, a contagious disease which attacks animals of the ox family, and is attended with the most deadly results. The disease appears to be identical with what was formerly known as murrain, and is sometimes called the **steppe-**

murrain, from the Russian steppes, which are its habitat. This disease has caused great havoc among cattle for at least a thousand years, spreading occasionally like a pestilence over Europe. In 1865-7 there was a very serious visitation of it. It appeared in a dairy in the north of London in the month of June, 1865, and spread with great rapidity. The treatment of the disease having proved a failure, the Privy Council adopted the policy of 'stamping-out' or killing all infected animals, while cattle fairs having proved powerful instruments in transmitting the disease, the movements of cattle were subjected to the most stringent regulations. During this outbreak between 200,000 and 300,000 cattle died of the plague, or were ordered to be killed on account of it. These measures were attended with beneficial results. It re-appeared again in 1867, but was speedily got under. The probable cause of the disease is a micro-organism which is found in the blood and all the discharges of the infected animals, and is capable of being transmitted indirectly by any of these to great distances. Sheep and other animals can be affected by the disease, but in a less intense form. The period of incubation varies from two to ten days. The symptoms are rise of temperature, followed by a heightened colour of the mucous membrane of the mouth, and granular yellowish eruptions on the gums, lips, tongue, palate, and cheeks. The skin becomes congested, and develops scales with papular eruptions, and finally a slimy discharge comes from the eyes and nose. Inoculation has been found effective against the disease.

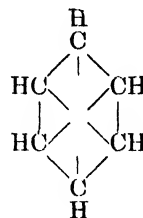
Ring. See *Jewellery*.

Ring, in chemistry. Organic chemistry is divided into two sections. To the one belong all carbon compounds having an open-chain structure, such as ethane, ethyl alcohol, acetic acid, &c.; to the other belong 'ring compounds', also called closed-chain or cyclic compounds. A ring in chemistry denotes a particular arrangement of the atoms in the molecule whereby carbon atoms are assumed to be linked together so that each carbon atom is united with at least two others, forming a closed chain. In investigating the structure of benzene it was noticed that, although the substance showed more unsaturation than ethylene or allylene, i.e. it contained more carbon in proportion to hydrogen than either of these, yet it behaved as a saturated compound in many respects. This led to the assumption that the valencies of the carbon atoms were not used up in the same way in benzene as in the open-chain saturated compounds. Kekulé (q.v.) was the first to suggest a ring structure for benzene. Originally few organic compounds were known, and these were divided into *aliphatic* compounds (those derived

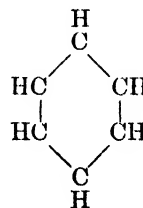
from fats and oils) and *aromatic* compounds (those derived from resins and balsams). Later, organic compounds of the aliphatic type, such as ethane and alcohol, were given structural formulæ, as a result of the researches of Frankland, Kekulé, and others on the valency of carbon, which they fixed as four. Benzene and its derivatives were still given molecular formulæ only, as these could not be fitted in as open-chain compounds. Kekulé then suggested that benzene has a ring structure, with each carbon atom linked to two other carbon atoms and to one hydrogen atom, thus:



The fourth valency of carbon he assumed to be used up in keeping the molecule stable. Each carbon atom here has its four valencies used up in some way. Using this formula, Kekulé was able to explain the properties of benzene and many of its derivatives. Numerous formulæ of the same type have been suggested for benzene, all based on Kekulé's ring structure, and differing only in the disposition of the fourth valency of the carbon atoms. Thus the 'centric formula' for benzene is:



The introduction of Kekulé's formula for benzene marked the start of enormous development in the study of aromatic carbon compounds. Benzene is usually represented as



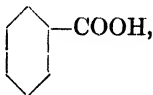
no account being taken of the fourth valency of

carbon (a very controversial subject); or, simply by a hexagon, as

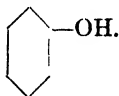


the carbon and hydrogen being understood. This latter symbol represents Kekulé's ring reduced to its simplest form, and is accepted by all chemists. Without its aid a large proportion of the dyes of the present day, and many valuable synthetic drugs, would probably never have been discovered.

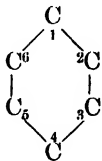
All benzene derivatives, acids, phenols, alcohols, &c., are derived from this by substituting a group or an atom for one or more atoms of hydrogen. Benzoic acid ($C_6H_5 \cdot COOH$) is represented as



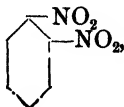
and phenol ($C_6H_5 \cdot OH$) as



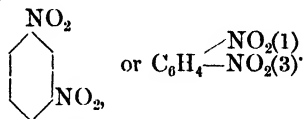
As each carbon atom is united to one hydrogen atom, and the arrangement is symmetrical, it does not matter which of the six hydrogen atoms is replaced. This is verified by experiment, only one *mono*-substitution product of benzene (of the type C_6H_5X) being possible. When more than one hydrogen, however, is replaced, it is necessary to indicate which hydrogens; that is, the ring is *orientated*, or the different carbon atoms are distinguished by numbers, thus



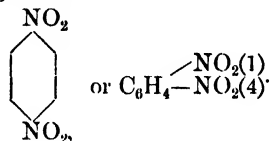
The pairs of hydrogen atoms occupying positions 1 and 2, 2 and 3, 3 and 4, 4 and 5, 5 and 6, 6 and 1 bear the same relationship, and no matter which of these pairs is replaced, only one disubstitution product will be obtained; this is known as the *ortho*-position. Thus, replacing two hydrogen atoms in benzene occupying one of these pairs of positions by a nitro group (NO_2), *ortho*-dinitrobenzene is obtained,



usually written simply $C_6H_4 \begin{smallmatrix} \diagup NO_2(1) \\ \diagdown NO_2(2) \end{smallmatrix}$. Again, the pairs of hydrogen atoms in the positions 1 and 3, 2 and 4, 3 and 5, 4 and 6, 5 and 1, 6 and 2 yield only one product; this is known as the *meta*-position. For example, replacing two hydrogen atoms by two nitro groups occupying any of these pairs of positions, *meta*-dinitrobenzene is obtained,



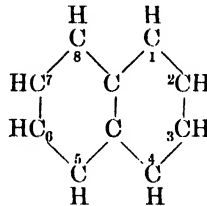
Lastly, the positions 1 and 4, 2 and 5, 3 and 6 have the same relationship to one another; this is known as the *para*-position. *Para*-dinitrobenzene is



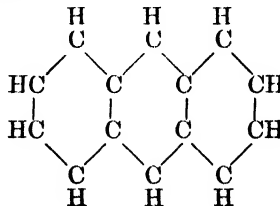
These are the only possible disubstitution products; this is proved by experiment, three disubstitution products of benzene being possible always, and only three.

When three substituents are introduced, the position of the substituent is indicated by the number of the carbon atom where substitution has taken place. Thus, trimethyl benzene may be 1-, 2-, 3-trimethyl benzene, or 1-, 2-, 4-trimethyl benzene, or 1-, 3-, 5-trimethyl benzene.

Besides the benzene ring, the simplest carbocyclic ring, more complex ring compounds are known. Thus, the hydrocarbon naphthalene ($C_{10}H_8$) is made up of two benzene rings 'condensed' together:



Anthracene, $C_{14}H_{10}$, contains three benzene rings united together:

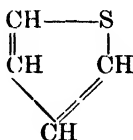
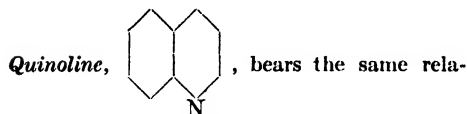
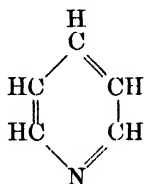


The character of derivatives of these depends on the position of the hydrogen replaced. Thus, from naphthalene are obtained α - and β -derivatives by replacing hydrogen in the α position or the β position; for example, α -naphthol is obtained by replacing one hydrogen by a hydroxyl group (OH) in the 1, 4, 5, or 8 position, β -naphthol by replacing the hydrogen in the 2, 3, 6, or 7 position.



Many very complex ring compounds are now known, especially among the dyes.

When the whole ring is not made up of carbon, the compound is termed *heterocyclic*. For example, *pyridine* contains one atom of nitrogen in the ring, and is represented thus:



Pyrrol, c1cc[nH]1, also contains only four atoms of carbon in its ring.

Ring-dotterel (*Ægialitis hiaticola*), a species of plover pretty common in Britain, where it frequents the shores of bays or inlets of the sea and of rivers. It has its name from a white ring round the neck.

Ring-dove, **Wood-pigeon**, or **Cushat** (*Columba palumbus*), the largest of the pigeons inhabiting Britain, a bird which occurs very generally throughout the wooded parts of Europe. It is migratory in countries in which the severe winters preclude the possibility of its obtaining a due supply of food, and even in Britain, in which it permanently resides, it appears on the approach of winter to assemble in flocks, and to perform a limited migration, probably in search of food. A bluish-grey colour prevails generally over the head, cheeks, neck, back, and rump, whilst the breast and under parts of the neck are of a purplish red, the belly and thighs dull white. A patch of white on either side of the neck forms a sort of ring or collar. The average length is about 16 or 17 inches. The food of the ring-dove consists of grain, acorns, berries, the leaves and tops of turnips, &c. The nests are composed of sticks and twigs loosely placed together. The birds are wary and shy, and rarely breed in confinement. They now frequent London parks.

Ringed-snake, a harmless colubrine snake (*Tropidonotus natrix*), with teeth so small as to be incapable of piercing the skin. It is common in England. It feeds on frogs, mice, young birds, &c., which it swallows alive. It is torpid during winter.

Ringworm, or **Tinea**, is a disease of the skin, hair, or nails, and is caused by a vegetable fungus. The most common form is ringworm of the scalp, which is essentially a disease of childhood, occurring most frequently between the ages of five and fifteen. It is common in schools and institutions, and is easily spread from one child to another by direct contact, by infected caps, hair-brushes, and the like. It appears first as a small scaly spot, about the size of a threepenny piece, with a few broken hairs on the patch. It is often overlooked at this stage, and when first noticed there may be several patches of varying size. If unchecked, it will continue to spread, and may persist for several years. Various forms of treatment have been tried in the past, but it is now generally accepted that by far the most efficient treatment for ringworm of the scalp is the application of the X-rays. Ringworm of the skin elsewhere can be removed in a few days by the application of strong tincture of iodine or antiseptic ointments. Ringworm of the nails is very resistant to treatment, and the condition may last for years.

Riobamba, a town of Ecuador, South America, capital of the province of Chimborazo. It is 9000 feet above sea-level, and is 85 miles from Guayaquil by rail. It is the seat of an Ecuadorian superior court of three judges. The present town of single-storied adobe huts dates only from 1797, when the ancient town of Riobamba, a much larger and more splendid place located some 8

miles away, was destroyed by an earthquake. Pop. 12,000.

Rio de Janeiro, a maritime state of Brazil; area, 26,627 sq. miles. It is very mountainous, being traversed longitudinally by the Serra do Mar. The principal river is the Parahyba. The most important products are sugar (for which the Parahyba Valley is celebrated), maize, and mandioca, besides valuable timber. Railways include the Central, connecting Rio with the Parahyba Valley, and tapping Minas Geracs and São Paulo; the Leopoldina; Rio do Ouro; and Melhoramentos. Pop. (1921), 1,501,970.

Rio de Janeiro (rê-o de zhâ-nâ'-rû), or simply **Rio**, a city and seaport of South America, the capital of the United States of Brazil, situated in 22° 54' s. lat., and 43° 10' w. long., at the entrance of the Bay of Rio de Janeiro, which forms one of the largest and finest natural harbours in the world. The bay extends northwards from the Atlantic for some 15 miles, and expands in width from about 1 mile at the entrance, to some 10 miles at its maximum. The narrow entrance between the Pão de Açúcar (Sugar Loaf, 1200 feet altitude) and the Pico is guarded by the forts of Santa Cruz (Pico side) and São João and Theodosio (Azucar side); and the islands of Cobras (a naval depot), Lage, and Villegaignon are also fortified. High mountains (Corcovado, 2329 feet altitude) clothed with luxuriant tropical vegetation enclose the bay on every side, and form a scene of the utmost grandeur and beauty.

The old town has narrow streets; it is the commercial district, and contains the usual public buildings. The National Library, opened in 1910, is the finest in Latin America. In 1904 a Municipal Theatre was designed which has cost over £2,000,000 to build, and seats 1700 people. The old Avenida Central was reconstructed in 1904, and is now called the Avenida Rio Branco. It is the finest street in all America. The fine botanical garden, with its avenue of palms, is well known. The largest square is the Praça da Republica, between the old and the new town. The chief suburbs are the Catete and Botafogo, Villa Isabel, Larangeiras, Engenho Novo, Copacabana, Rio Comprido, Andarahy, and Jardim.

There is a naval school on the island of Enxadas. Rio de Janeiro is the chief terminus of the Brazilian railways, and its streets are traversed by several systems of electric and other tramways. A cog-wheel railway runs to the top of Corcovado. The Leopoldina Railway runs a branch service to Petropolis, and the Central do Brazil, Melhoramentos, and Leopoldina systems maintain trunk-line communication with the interior. There is a narrow-gauge line to the waterworks at Rio do Ouro. The magnificent port-works provide ample accommodation and facilities for the rapid

loading and unloading of ships. There is steamship communication with all parts of the world.

Climatically, Rio de Janeiro is an unpleasant place; it is hot, humid, and debilitating, the average temperature being about 75° F., and the rainfall 44 to 45 inches. The temperature ranges between 40° F. and 100° F., according to season. In 1903 President Rodriguez Alves inaugurated a campaign of hygiene and health, which was conducted under the direction of Dr. Oswaldo Cruz. The sanitation schemes then devised, and now rigorously carried out, have made the city one of the healthiest tropical cities in the world.

Rio is the seat of the Federal Government of Brazil, and constitutes a Federal district distinct from the state of Rio de Janeiro, but, unlike the Federal District of Columbia (United States), it has an elected municipal council (24 members sitting for three years). There is also a Prefect, who is chosen by the President of the Republic and holds office for four years. It is the see of an archbishop of the Roman Catholic Church.

In the city there are over 1200 factories of all kinds, which employ some 47,000 operatives. The principal manufactures are flour, textiles, soap, liquors, mineral waters, stearin candles, printing-type, biscuits, sugar, tobaccos, furniture, rolling-stock and vehicles, ice, beer, macaroni, and machinery. The imports and exports from the port are identical with those of Brazil (q.v.).

The bay was discovered by a Portuguese captain on 1st Jan., 1531, and mistaken for a river estuary, whence the name ('River of January'). The French occupied the island of Villegaignon in 1555, but the Portuguese expelled them in 1567, about which time Rio was founded. It became the capital of Brazil in 1763. Pop. (1920), 1,160,000.—Cf. A. J. Lamoureux, *Hand-book of Rio de Janeiro*. Most treatises on Brazil deal with Rio.

Rio de Oro, a territory belonging to Spain on the west coast of Northern Africa, extending from Cape Bojador to Cape Blanco; area, 70,000 sq. miles. It was annexed in 1887, and its inland boundaries were settled in 1901 by an agreement with France. The population of Rio de Oro and Adrar is approximately 500.

Rio-Grande-do-Norte (Grand River of the North), a maritime state at the north-east angle of Brazil; area, 22,189 sq. miles. The surface is mountainous; the climate is hot, dry, and healthy. Agriculture (sugar, coffee, wax, rubber, cochineal, and tobacco) and cattle-rearing form the principal branches of industry. The capital is Natal. Pop. of state, 1,501,970.

Rio-Grande-do-Sul, the most southern state of Brazil, bounded partly by the Atlantic, and bordering with Uruguay and the Argentine Republic; area, 91,310 sq. miles; pop. (1920),

2,138,830 (or 23.4 per square mile). There is a low coastal plain occupied by lagoons, chief among which are the Lagoa dos Patos and Lagoa Mirim. The Jacuhy (300 miles), with its tributaries the Taquary and the Vaccacahy, is the principal river. The climate of the state is temperate and mild, but is semi-tropical in the coastal plain. The chief occupations of the inhabitants are cattle-rearing and agriculture. Coal deposits are extensive. There are some 1700 miles of railway. Hides, tallow, horse-hair, bones, &c., are exported. The capital is Porto Alegre.

The Brazilian railways are divided up into a series of independent systems, one of which is centred in Rio-Grande-do-Sul. The principal State lines are the Quarahim-Itaquai-São Borja (about 160 miles), which runs from the north-west of the Uruguay system northwards along the Uruguay River to Uruguayana, Itaquai (a naval station), and to São Borja; the Porto Alegre-Cacequy-Uruguayana line (393 miles), which branches at Cacequy for Livramento, and the Uruguayan system and (another line) for Bagé (129 miles) to join the Rio Grande-Bagé trunk line (175 miles); and the line which joins the Porto-Alegre-Cacequy line at Sta Maria, and runs northwards with various extensions to the Uruguay River and the state of Santa Catharina.

Rio-Grande-do-Sul, a seaport-city of Brazil, in the state of Rio-Grande-do-Sul, situated on the Rio Grande, or outlet of the Lagoa dos Patos. The city is the seaward terminus of the Bagé line, which has dock and harbour extensions; and it has a direct steamship service with Porto Alegre and with Europe. Yerba-maté, hides, hair, wool, tallow, dried meat, and tobacco are exported. Brewing is carried on. Rio Grande was founded in 1737, and became a *cidade* (city) in 1807. Pop. 35,000.

Rioja, La, a western province of Argentina. The east and south are more or less arid; the west is well watered, and the smaller streams of the north are used for irrigation purposes. The climate is dry and healthy, but is generally so hot as to make agriculture and mining unattractive. Mining is the principal industry, gold, copper, cobalt, silver, nickel, tin, and salt being among the minerals worked. Fruit is grown in the irrigated sub-montane regions, citrus fruit being especially favoured. Area, 37,839 sq. miles; pop. (1921), 84,643.

Rioja, La, a town of Argentina, capital of the province of La Rioja, on the slopes of the Sierra de Velasco; famous for its wines. It is on the Cordova-Tucuman trunk line and a Catamarca branch. Pop. (1921), 8250.

Riom (rê-on), a town of France, in the department of Puy-de-Dôme, on the Ambère; served by the Lyons Railway, of which it is a junction. The chief manufactures are linen, silk, and hardware. Pop. 10,500.

Rion. See *Poti*.

Rio Negro (Sp., 'black river'), the name of numerous streams, of which two are important: (1) A river of South America, and principal tributary of the Amazon. It rises in Colombia, and

joins the Amazon at Manaus after a course of about 1000 miles. Through its affluent, the Cassiquari, there is direct communication between the Amazon and Orinoco. See *Cassiquari*. (2) A river in the Argentine Republic. It rises in the Andes, and is about 700 miles long; its current is very rapid, and its bed much obstructed.

Rio Negro, a territory of the Argentine, in Patagonia, between the Atlantic and the Andes. Between the Rivers Negro and Colorado there is an irrigated area which is used for pastoral and agricultural purposes. The capital is Viedma, on the Rio Negro, and there is a military station, General Roca, which is connected with Buenos Aires and Bahia Blanca by an extension of the Great Southern Railway. Area, 79,805 sq. miles; pop. (1921), 47,700.

Rio Negro, a riverine department of Uruguay, bounded on the south by the Rio Negro, and on the west by the Uruguay. It is flat and devoted to stock-raising and general agriculture. Area, 3230 sq. miles; pop. 39,040.

Riot. By the English common law a riot is an unlawful assembly of three or more persons which has actually begun to execute the common purpose for which it assembled by a breach of the peace, and to the terror of the public. A lawful assembly may become a riot if the persons assembled form and proceed to execute an unlawful purpose to the terror of the people, although they had not that purpose when they assembled. Every person convicted of riot is liable to be sentenced to hard labour. In Scots law rioting is termed mobbing. A person may be guilty of mobbing who directs or excites a mob although he is not actually present in it. Mere presence without participation may constitute mobbing. By Act 1 George I cap. v. s. 2, called the *Riot Act*, whenever twelve or more persons are unlawfully assembled to the disturbance of the peace, it is the duty of the justices of the peace, and the sheriff and under-sheriff of the county, or of the mayor or other head officers of a city or town corporate, to command them by proclamation to disperse. And all persons who continue unlawfully together for one hour after the proclamation is made, commit a felony, and are liable to penal servitude or imprisonment (substituted for death by 7 Will. 4 and 1 Vict.). The Act also contains a clause indemnifying the officers and their assistants in case any of the mob should be killed or injured in the attempt to arrest or disperse them. Compensation out of the rates is paid to persons sustaining damage by riot.

Rio Tinto Mines, a copper-mining area in the south-west of Spain, province of Huelva, near the Rio Tinto. The town of Rio Tinto has 10,000 inhabitants. Huelva is the export seaport for the mines, which yield an annual average

of about 1,000,000 tons of pyrites containing copper ore and sulphur.

Ripley, an urban district of Derbyshire, England; served by the Midland Railway. There are iron-works, boiler-works, and manufactures of wicks and braids. Pop. 11,800.

Rip'on, a cathedral city and municipal borough of England, in the county of York (West Riding), on the Ure; served by the North-Eastern Railway. The cathedral dates from the latter half of the twelfth century, and has two towers, each 110 feet high. It was restored between 1862 and 1876, and is one of the finest churches in England. Ripon has manufactures of machinery, saddle-trees, and leather. The city was made the seat of a bishop in 1836. Pop. (1921), 8389.

Risca, an urban district of Monmouthshire, England, on the Ebbw; served by the Great Western Railway. Collieries, tinplate-works, and chemical-works provide the chief employments. Pop. (1921), 16,750.

Risto'ri, Adelaide, Italian actress, born in 1822, died in 1906. Among her chief characters were Medea, Francesca da Rimini, Marie Antoinette, Mary Stuart, and Lady Macbeth. She took her farewell of the English stage in 1873.

Ritornel'lo (It.), in music, a short repetition as of the concluding phrases of an air; or a passage which is played whilst the principal voice pauses. Ritornelli are also Italian popular songs in stanzas of three lines each.

Ritschl (richl), Albrecht, German theologian, born at Berlin in 1822, died in 1889. He studied at Bonn, Halle, Heidelberg, and Tübingen, became professor of theology at Bonn, and in 1864 was appointed to the chair of theology at Göttingen. Although in his early thesis he adopted the position of his master, F. C. Baur, the second edition of his *Origin of the Early Catholic Church*, in 1857, marked his complete severance from the Tübingen school. His chief subsequent works are: *De Ira Dei*; *The Christian Doctrine of Justification and the Atonement* (3 vols.), his principal work; *Christian Perfection*; *Instruction in the Christian Religion*; *On Conscience*; *History of Pietism* (3 vols.); *Theology and Metaphysics*; and *Collected Essays*. Ritschl founded a school of theology still of much importance both in Germany and elsewhere. He sought to eliminate the whole metaphysical element from religion, and was thus led to reject such doctrines as original sin, the Trinity, and the incarnation as of no religious value. He condemned mysticism of every kind, laid stress on the historical character of Christianity, but held free views of inspiration, and admitted the most advanced criticism.—Cf. A. E. Garvie, *The Ritschlian Theology*.

Ritson, Joseph, English literary antiquarian, born 1752, died 1803. He became a conveyancer in London and deputy-high-bailiff to the Duchy

of Lancaster, and edited many old and rare books. He was noted for his industry and integrity, but was a quarrelsome critic. His chief works are: *A Select Collection of English Songs* (1783), *Ancient Songs from the Time of King Henry III to the Revolution* (1792), *A Collection of Scottish Songs* (1794), *Robin Hood Poems* (1795), and *Ancient English Metrical Romances* (1802).

Ritualism is a depreciatory term used in ecclesiastical circles to describe a system of worship which appears to attach undue significance to ritual in the Christian religion.

In Christianity differences of custom and usage have been marked from the first; but 'ritualism', in the strict sense of the term, has emerged mainly in connexion with the Church of England. One of the early controversies between the Puritans and the Church turned on the place of sacramental and symbolic expressions of religious faith, the Puritans, largely under a Biblical influence, protesting against the practices which the Church persisted in carrying on as part of its catholic inheritance. Last century the struggle assumed fresh and fierce forms. The revival of mediæval practices in worship preceded the Oxford movement, but the influence of the Tractarians led to developments which went far beyond what the early Tractarians intended or even permitted. The troubles began about 1859, when some Anglican clergymen introduced practices like absolution, the eastward position, and the use of vestments in celebrating the sacrament. These involved riots in some churches, ecclesiastical trials, and parliamentary legislation, including the ineffective Public Worship Regulation Act of 1874, which was designed, in Lord Beaconsfield's words, "to put down ritualism". Ritualism was not put down, and the main practices advocated by the reformers are now widely observed in English churches of the 'High' order.

The six points insisted upon were: (a) the right to use eucharistic vestments; (b) the mixed chalice, i.e. mixing water with wine in the sacramental cup; (c) the wafer of unleavened bread; (d) the use of the eastward position at the altar by the celebrant; (e) the use of incense; and (f) of altar lights. The majority of these practices are obviously connected with the celebration of the eucharist, and indeed 'ritualists' insist upon ritual for the sake of its dogmatic importance, as the expression of faith in the real presence of the Deity, concentrated in the eucharist. This is the central issue. The ritual practices are no more than the outward form of this inner belief. The God is assumed to be present on the altar, in the wafer. Hence even the lights are in honour of Him, not to beautify the church nor to impress the worshipper; their function is to show homage to the divine Guest.

It was this idea—the idea of the Roman Mass—which naturally led to the antipathy shown at first to the ritualists, who were accused of incipient Popery. Ritualism was the term applied to all tendencies in public worship which “indicate a design to alter at least the ceremonial of religion established in and by the nation, for the purpose of assimilating it to the Roman or Popish ceremonial” (W. E. Gladstone). The suspicion and the alarm were not altogether unnatural, though they proved to be exaggerated. To the fear of an insidious propaganda of Romanism by clergymen in the pay of the national Church was added, on broader lines, the dislike felt by genuinely religious people to what they considered the reintroduction of adventitious and superstitious forms in worship, which were mediæval rather than Christian.

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Ritual Murder, or Blood Accusation, the accusation levelled against the early Christians and constantly against the Jews of requiring and employing human blood in connexion with religious ceremonies and for ritual purposes. During the Dark Ages the charge was brought against the Jews, who were accused of requiring Christian blood for their Passover ceremonies. Numerous have been such cases of blood accusation, from the first instance which occurred at Norwich in 1144 to the famous Beiliss case in Russia in the present century. Trustworthy Christian scholars (not to speak of Jewish savants) have, however, solemnly declared—furnishing unassailable proofs—that there is absolutely no Jewish ritual prescribing the use of blood of any human being, and that, on the contrary, the laws of the Jews command them “not to defile themselves with blood”. These scholars have also proved conclusively that no Jewish sect has ever been guilty of such a ceremony. The best and most recent work on the subject is *The Jew and Human Sacrifice*, by Professor H. Strack.—Cf. article in *Jewish Encyclopædia*.

Rlu-Klu. See *Ryu-Kyu*.

Rive-de-Gier (rêv-dé-zhyā), or simply **Rive**, a town of France, in the department of Loire, on the Gier. The coal-field which surrounds the town is the most valuable in France. There are glassworks, spinning and other mills, foundries, machine- and iron-works. Pop. 15,800.

Rivera, a department of North-Eastern Uruguay, bounded on the north by the Brazilian state of Rio-Grande-do-Sul. Rivera, in the extreme north of the department, is the capital. The state is served by the north-eastern line of the Uruguayan combined system, whose ter-

minus is at Rivera. Cattle are exported. State area, 3793 sq. miles; pop. (1921), 48,350. Pop. (city) about 10,000. See *Uruguay*.

River-crab, a name given to a genus of crabs (Thelphusa), inhabiting fresh water, and having the carapace quadrilateral and the antennæ very short. In structure it is intermediate between shore-crabs and land-crabs. One species (*T. fluviatilis*) inhabits muddy lakes and slow rivers in the south of Europe.

Riverside, a city of California, United States, the county seat of Riverside county, on the Santa Ana; served by the Atchison, Topeka, & Santa Fé, the Southern Pacific, and the San Pedro, Los Angeles, & Salt Lake Railways. Citrus fruit is produced locally. Riverside is the focus of the finest orange-growing district of California. Pop. 20,000.

River-tortoise, a name of certain aquatic tortoises which come to shore only to deposit their eggs. They are exclusively carnivorous, subsisting on fishes, reptiles, birds, &c. The edges of the mandible are so sharp and firm that they easily snap off a man's finger. Well-known species are the soft-shelled turtle (*Trionyx ferox*) and the large and fierce snapping turtle (*Chelydra serpentina*) of America. (See *Snapping-turtle*.) They inhabit almost every river and lake in the warmer regions in the Old and New Worlds, and *Trionyx gangeticus* is plentiful in the Ganges, where it preys on human bodies. See *Tortoise*.

Rivet, a short cylindrical piece of steel, wrought iron, copper, or other malleable metal, formed with a head and inserted in a hole through both of two pieces of metal, after which the point is hammered out to keep the two pieces closely bound together. The heads are made either of the snap or pan shape. The points are made countersunk, snap, or conical. In machine riveting snap heads are the most commonly used, but where a flush surface is required, as in shipbuilding, countersinking is common. The conical form is only used where the space for working is so restricted as only to permit of hammering. The punching of rivet holes has a marked effect on the strength of plate or girder iron. In boiler-work it is customary to specify that all rivet holes be drilled, to reduce the effects upon the material of the plate. Many different types of riveted joints are necessary in steel construction, such as single, double, or chain-riveted lap joints and butt joints. Riveting is usually performed with hydraulic tools, but hand operations are frequently necessary. Ralph H. Tweddell introduced hydraulic riveting in 1865.

Riviera, the narrow highland coastal belt of the *compartimento* of Liguria, which strictly includes only the region between Nice and Spezia, but is popularly extended to embrace the whole

coast of the department of Alpes-Maritimes and the Italian seaboard as far as Leghorn. The Riviera sweeps in a curve round the Gulf of Genoa, and is divided by Genoa into a western portion, the *Riviera di Ponente* ('the coast of the setting sun'), and an eastern portion, the *Riviera di Levante* ('the coast of the rising sun'). Nice, Monaco, Monte Carlo, Mentone (all in France), Ventimiglia, Bordighera, Ospedaletti, San Remo, Porto Maurizio, Oneglia, Diano Marina, Alassio, Arenzano, and Pegli are in the Riviera di Ponente; Nervi, Santa Margherita, Rapallo, Chiavari, Sestri Levante, Levanto, and Spezia are in the Riviera di Levante. Cannes, Grasse, Antibes, Fréjus, and Hyères, all west of Nice and in the department of Alpes-Maritimes, are frequently spoken of as Riviera towns. All are served by the coastal railway which passes through Nice and runs to Spezia, a distance of about 172 miles. The great attractions of the Riviera are the mildness of the winter climate, the beauty of the natural surroundings, the exceptional facilities for sea-bathing, and the casinos. Although Liguria in general, and the Riviera in particular, are peculiarly susceptible to seismic disturbances, there is a complete chain of houses, villas, villages, and towns between the most easterly and the westernmost limits of the Gulf of Genoa. Bananas, pomegranates, dates, and prickly pears flourish, and the flora generally is of a sub-tropical character.

Riviere (ri-vēr'), Briton, subject and animal painter, born in London 1840, died 1920. He was elected A.R.A. in 1878, and R.A. in 1881. Among his chief pictures, many of which have been engraved, are: *Circe, An Anxious Moment, In Manus Tuas, Actæon, Væ Victis, Rixpah, A Fool and his Folly, A Mighty Hunter before the Lord, Beyond Man's Footsteps, Apollo, To the Hills, Aphrodite*.

Riv'oli, a town of Piedmont, North Italy, in the province of Turin. The environs are studded with villas belonging to the wealthy inhabitants of Turin, with which it is connected by rail. Silk and macaroni are made. Pop. 8000.

Rivoli-Verone'se, a village of Venetia, North Italy, between Lake Garda and the right bank of the Adige, 14 miles north-west of Verona. Here Napoleon, with Joubert and Masséna, defeated the Austrians on 14th Jan., 1797.

Rizzio, David, a native of Turin, born about 1533, died 1566. He came to Scotland in 1564 in the train of the Ambassador from Savoy, and soon became so great a favourite with the queen that he was appointed her secretary for foreign languages. The distinction with which he was treated by his mistress soon excited the envy of the nobles and the jealousy of Darnley. A conspiracy, with the king at its head, was formed for his destruction, and before he had enjoyed

two years of court favour the Lord Ruthven and others of his party were introduced by Darnley into the queen's apartment, where they murdered Rizzio. See *Mary Stuart*.

Roach (*Leuciscus rutilus*), a species of freshwater fish of the carp family (Cyprinidæ), found in Great Britain.

Roads and Pavements. The Romans set an example in road-building, for in all the lands they invaded they constructed highways for service in facilitating the movements of troops. These roads, many of which exist to this day, made travel easy, and thus helped to spread Roman civilization throughout their territories. In spite of this good beginning, road-making remained in a very wretched state until towards the end of the eighteenth century. The improvement in roads began in England at a later date than in many Continental countries.

In determining the route of a main road natural obstructions and differences of levels must be considered, as well as directness of route, the deviations necessary to pass through important centres of population, and expense of upkeep. The early British road-makers, such as Telford, considered a rise of 1 in 24 as the maximum, but, except in extreme cases, endeavours are now made to keep the gradients smaller than that value.

Every road has a foundation, a base, and a top layer. The base may be built up of broken stone and cement, while the top layer may be made of sand, gravel, or granite chips mixed with tar, or of wood blocks. Roads are made with a *camber* to assist the draining of water from the surface.

Early in the nineteenth century Macadam introduced the system known by his name, in which rough, angular, broken pieces of granite were allowed to knit themselves together into a compact mass under the action of the traffic, assisted by a small amount of water and bonding material. The roads produced by this inventor were a great improvement on those in use before his time. The term macadam road is used today for a type of construction which is hardly compatible with the engineer's intentions. When the road-making operations had to be performed at a greater rate than was common in Macadam's time, the steam-roller was introduced, with a much freer use of water. The new roads are very different from those of Macadam, and have a comparatively short life. In dry weather they become unbearable because of the dust, and in wet weather they are covered with mud. To discriminate between this type of road-making and the work of Macadam, which was excellent for the type of traffic then to be accommodated, many engineers prefer to use the term 'water-bound' for the modern product.

Traffic is not the only agent of destruction at work on roads, for perhaps the major action is that of the weather, which can, however, be considerably reduced by the effective waterproofing of the road surface and the provision of suitable drainage for the foundation. The common mediums for waterproofing are tar or bitumen preparations.

Wood paving has proved very effective as a material for roads, especially where the softer woods are used. Jarrah wood and beech blocks are the most suitable for this purpose. The harder woods 'cobble' at the edges.—Cf. Law, Clerk, and Wallis-Taylor, *Roads and Streets*.

Robert, Duke of Normandy, surnamed *the Devil*. The younger son of Duke Richard II by his marriage with Judith, a daughter of Count Godfrey of Brittany, he succeeded his elder brother, Richard III, in 1027. The first years of his government were employed in bringing his rebellious vassals into subjection, and he then restored Count Baldwin of Flanders to his states. In 1033 he set out to visit the holy places, and subsequently made the pilgrimage to Jerusalem on foot. While returning he died suddenly at Nicaea, in Asia Minor (1035). He is supposed to have been poisoned by his servants. His heroic deeds and penance have given rise to numerous stories. William the Conqueror was his son.—Cf. E. A. Freeman, *History of the Norman Conquest*.

Robert II, King of Scotland, born 1316, died 1390. He was the son of Marjory, daughter of Robert Bruce, and of Walter, Steward of Scotland, and was thus the first of the *Stewart* or *Stuart* kings. Recognized by Parliament in 1318 as heir to the crown, he succeeded David II, and was crowned at Scone, 26th March, 1371. He had long acted as regent, and had done good service in the English wars. An Act of Parliament in 1375 settled the crown on his sons by his first wife, Elizabeth Mure of Rowallan, illegitimate by ecclesiastical law. His reign was comparatively a peaceful one, one of the chief events being the battle of Otterburn. — Cf. Andrew Lang, *History of Scotland*.

Robert III, King of Scotland, eldest son of the preceding, was born in 1340, and died in 1406. He was originally called John, but changed his name on his coronation in 1390. Having been lamed by accident, he was unable to engage in military pursuits, and he trusted the management of affairs almost entirely to his brother, whom he created Duke of Albany. In 1398 Albany was compelled to resign his office by a party who wished to confer it on the king's eldest son, David, Duke of Rothesay. War was renewed with England, and the battle of Homildon Hill, 14th Sept., 1402, resulted in a disastrous defeat of the Scots. In this year the Duke of Rothesay died in Falkland Castle, where he had been imprisoned; and

it was commonly believed that he was starved to death at the instigation of Albany. Dread of Albany, who had recovered the regency, induced the king to send his second son, James, to France in 1406; but the vessel which carried him was captured by the English, and Henry IV long detained him as a prisoner. Soon after this event Robert died.—Cf. P. F. Tytler, *History of Scotland*, and Scott, *Fair Maid of Perth*.

Robert of Gloucester, an English historian, is supposed to have been a monk in the abbey of Gloucester during the reign of Edward I, but of his private history nothing is known. His history of England, in verse, extends from the period of the fabulous Brut to about A.D. 1300.

Roberts, Bartholomew, pirate, born 1682, died 1722. (Cf. *Piracy*.) He plundered in the vicinity of Barbados, Dominica, Newfoundland, &c., and was killed in action against H.M.S. *Swallow*, his two ships (*Royal Fortune* and a small sloop) being destroyed.

Roberts, David, painter, was born in Edinburgh in 1796, died in 1864. He first worked as a house-painter, then became a scene-painter, and in 1822 was engaged as such for Drury Lane Theatre. In 1848 he exhibited *The Chancel of the Church of St. Paul, Antwerp*, now in the National Gallery. *Rome: Sunset from the Convent of San Onofrio* is in the Edinburgh National Gallery, *Pyramids from the Nile* and *The Great Temple of Edfou, Egypt* in the South Kensington Museum.

Roberts, Frederick Sleigh, the future Earl Roberts of Kandahar, Pretoria, and Waterford, V.C., K.G., K.P., G.C.B., O.M., G.C.S.I., G.C.I.E., affectionately known to the army as 'Bobs', was the son of General Sir A. Roberts, an officer of the Indian army. He was born in 1832 at Cawnpore, where his father was in command. After passing through Eton and Sandhurst, he received a commission in the Bengal Artillery of the East India Company (1852). Two years later he became D.A.Q.M.G. at Peshawur, and spent the greater part of the next twenty years in that branch of the staff, being appointed Q.M.G. in India in 1873.

At the outbreak of the Mutiny in 1857 Roberts accompanied the Punjab mobile column in the capacity of staff officer. Eventually he made his way to Delhi, where the scanty British force was just holding its own, and on his arrival he was appointed Assistant Q.M.G., and served in this capacity till the city fell in the following September. From Delhi he went to Cawnpore, then to Lucknow, where he performed the deed which brought him the Victoria Cross. After a visit home, during which he married, he returned to India in July, 1859, and took up his duties at Simla as Assistant Q.M.G., Army Head-quarters. In 1860, on the assumption of the government

of India by the Crown, Roberts elected for transfer to the Royal Artillery, into which he was received as second captain, with the brevet of major. The year 1863 saw him engaged on the North-West Frontier in the Umbeyla Campaign against the Bunerwals. In 1867-8 he was employed with the Abyssinian Expeditionary Force, and was given the brevet of lieutenant-colonel. The Lushai Expedition of 1871 brought him a c.b. and promotion to Deputy Q.M.G. in Simla, which post he held till 1873, when he became Q.M.G. in India. On the outbreak of war with Afghanistan (1878) Roberts, who since 1875 had been a full colonel, took over command of the Kurram Field Force assembling at Kohat. This force crossed the border on 21st Nov., fought a successful action at the Peiwar Kotal on 2nd Dec., and restored order in Kurram. In accordance with the terms of the Treaty of Gandamak a British envoy was sent to Kabul, and his murder and the dispatch of a punitive force culminated in the brilliant march by Roberts's mobile column to the relief of Kandahar. The idea was Roberts's own, and he began his march of 313 miles on 11th Aug., reaching and relieving Kandahar on the 31st. Shortly after, the British armies were withdrawn from Afghanistan, and for his services Sir Frederick Roberts was appointed commander-in-chief of the Madras army. After the Majuba disaster Roberts was asked to go out to Natal as Governor and commander-in-chief; he accepted, and reached Natal only to turn round and come home again, a change of Government having brought about a reversal of policy. From 1881 to 1885 (he was promoted lieutenant-general in 1883) he was commander-in-chief of the Madras army, and in Nov., 1885, he became commander-in-chief in India, continuing in this high position till April, 1893, or two years longer than the usual period. During his tenure of the chief command he was promoted general (28th Nov., 1890), and raised to the peerage under the title of Baron Roberts of Waterford and Kandahar (20th Feb., 1892).

In 1893 Lord Roberts left India and returned home, and two years later was offered, and accepted, the chief command in Ireland, having been promoted field-marshal on 25th May. Then, before the tenure of this appointment had expired, the South African War broke out (Oct., 1899), and in December of that year Lord Roberts went out as commander-in-chief. Returning home, he assumed the highest office a soldier could then aspire to, and became commander-in-chief of the army in succession to Lord Wolseley. On 11th Feb., 1901, he was created Viscount St. Pierre and Earl Roberts. In 1904 the office of commander-in-chief of the army was abolished; Lord Roberts, therefore,

was the last of a long line of distinguished soldiers to fill this post.

Even in retirement, after fifty-two years of active service, Lord Roberts could not remain inactive, but employed a great part of his time in advocating the necessity for some form of universal military training in preparation for the struggle which he knew must come. When at last it did arrive, nothing would suit 'Bobs', in spite of his eighty-two years, but to be with his comrades in France, where he died on 14th Nov., 1914.

Bernard Partridge's cartoon in *Punch* of 25th Nov., 1914 (*A Pattern of Chivalry*), with the wording,

This was the happy warrior. This was he,
That every man in arms should wish to be,

most worthily strikes the right note. Lord Roberts's heir, Lieutenant Roberts, was killed while endeavouring to save the guns at Colenso (South African War). He also was awarded the Victoria Cross. Lord Roberts's earldom was left by special remainder to his daughters and their heirs, the present holder of the title being his eldest surviving daughter.

Lord Roberts's book *Forty-one Years in India* is a marvellous record of soldiering from 1852 to 1893.

Robertson, Frederick William, British divine, born in London 1816, died in 1853. He was educated at the grammar-school of Beverley, Edinburgh Academy, and Edinburgh University. Failing to obtain a commission in the army, he matriculated at Brasenose College, Oxford, in 1837. In 1847 he became incumbent of Trinity Chapel, Brighton, and continued in this charge with increasing fame as a preacher till his death. His views were alleged to be heterodox and socialistic.

Robertson, Thomas William, dramatist, born 1829, died 1871. His parents being actors, he early went on the stage, but was never a success. In 1853 he settled in London, where for several years he struggled on with light literature. In 1864 he had considerable success with *David Garrick*, a play produced by Sothorn; but his fame rests on a series of plays produced at the Prince of Wales' Theatre (1866-70), including *Ours*, *Caste*, *Play*, *School*, and *M.P.* Though sneered at on their production by certain critics, and nicknamed 'cup-and-saucer dramas', they were distinctly above the level of contemporary drama, being excellent acting plays. Robertson was a master of stagecraft, and had a hearty and altogether wholesome sense of humour.

Robertson, William, historian, was born at Borthwick, in Midlothian, where his father was minister, in 1721, died in 1793. His *History of Scotland during the Reigns of Queen Mary and*

King James VI appeared in 1759 (2 vols. 4to). This work led to the author's appointment as principal of the University of Edinburgh in 1762. Two years after he was made historiographer-royal for Scotland. His *History of the Reign of Charles V* appeared in 1769, his *History of America* in 1777, and in 1791 *An Historical Disquisition concerning the Knowledge which the Ancients had of India*. As an historian he is admired for skilful and luminous arrangement, distinctness of narrative, and highly graphical description. His style is pure, dignified, and perspicuous.

Robespierre (rob-es-pi-är), Maximilien François Marie Isidore, French revolutionist, born at Arras 1758, executed 1794. The son of an advocate, he was educated at the College of Louis-le-Grand at Paris. He afterwards practised as an advocate at Arras, and held for a short period the position of judge in the bishop's diocese. In 1789 he was elected deputy to the States-General, and was a zealous supporter of democratic measures. At this time he became a prominent member of the Jacobins and other revolutionary clubs. In March, 1791, he was appointed public accuser to the New Courts of Judicature, and elected a member of the Convention. In the proceedings against Louis XVI he distinguished himself by the relentless rancour with which he opposed every proposal to avert or delay the fatal result. On 24th March, 1794, the Hébertists fell victims to his jealousy. A week later he caused Danton to be arrested, who, after a trial of four days, was guillotined, together with Camille Desmoulins, on 5th April. Robespierre's power now seemed to be completely established, and the Reign of Terror was at its height. On 7th May, 1794, he, as President of the Convention, was the chief agent in making the Convention decree the existence of the Supreme Being; and on 8th June he celebrated the Feast of the Supreme Being. In the meantime a party in the Convention was formed against Robespierre, and on 27th July he was openly accused of despotism. A decree of arrest was carried against him, and he was thrown into the Luxembourg prison. He was released by his keeper on the night of the same day, and conducted to the Hall of Commune, where his supporters were collected. On the following day Barras was sent with an armed force to effect his arrest. Robespierre's followers deserted him, and he was guillotined on 28th July, 1794, together with some twenty-three of his supporters. The tendency with modern writers is to modify the character for infamy which at one time obtained regarding Robespierre.—BIBLIOGRAPHY: G. H. Lewes, *Life of Maximilien Robespierre*; H. Belloc, *Robespierre*; C. F. Warwick, *Robespierre and the French Revolution*.

Robin, a name given to several birds, more

especially to the robin redbreast of Europe (see *Redbreast*) and to an American species of thrush (*Turdus migratorius*), as also to the bluebird of America. See *Bluebird*.

Robins, Benjamin, mathematician and artillery, born at Bath in 1707, died in 1751. He was self-educated, and attained an extraordinary knowledge of mathematics, a subject which he taught in London. He also made experiments on projectiles, and his chief work, *The New Principles of Gunnery*, appeared in 1742. In 1749 he became engineer-in-chief to the East India Company, and fortified Madras, where he died of fever.

Robinson, Henry Crabb, British journalist, born at Bury St. Edmunds 1775, died 1867. He was intimately acquainted with almost every man of eminence in his time, and his *Diary*, *Journals*, and *Reminiscences* are a perfect mine to students of literary and social history. Selections were edited and published by T. Sadler in 1869.

Rob Roy (that is, 'Robert the Red'), a celebrated Highland freebooter, born in 1671, died in 1734. He was the younger son of Donald Macgregor of Glengyle, by his wife, a daughter of Campbell of Gleneaves. Like other Highland gentlemen of this period, Rob Roy was a trader in cattle previous to the rebellion of 1715, in which he joined the adherents of the Pretender, also carrying on operations against the Government on his own account. See Sir Walter Scott's Introduction to the novel of *Rob Roy*.—Cf. A. H. Millar, *Story of Rob Roy*.

Roc'ambol (*Allium scorodopræsum*), a species of onion, having bulbs resembling those of the garlic. It is cultivated for the same purposes, and is considered as having a more delicate flavour.

Rocha, a maritime department of South-Eastern Uruguay. The chief industry is stock-raising, but some minerals, chiefly lead, iron, and copper, are found. The capital is Rocha (pop. 5000). Communications are afforded by the State-operated line between La Paloma and Rocha (20 miles). Area of the department, 4280 sq. miles; pop (1921), 50,000.

Rochambeau (ro-shān-bō), Jean Baptiste Donatien de Vimeur, Comte de, Marshal of France, born in 1725, died in 1807. He entered the French army in 1742, distinguished himself in the Seven Years' War, and became field-marshal in 1761. From 1780 to 1782 he commanded the French forces sent to aid the revolted British colonists in America.

Rochdale, a municipal and county borough of Lancashire, England, on the Roch; served by the Lancashire & Yorkshire Railway. Rochdale, which derives its name from the river, is a place of considerable antiquity, and was early noted for its woollen manufactures, which have re-

mained a chief staple till the present day. Cotton is extensively manufactured, and there are also foundries and machine-shops, while in the neighbourhood are stone-quarries and extensive collieries. The parish church (St. Chad) was founded in the twelfth century. The other chief buildings are the town hall, free library, technical school, grammar-school, and school of art. The Equitable Pioneers Society (1844) was the first co-operative society. By means of canals Rochdale has water communication with all the industrial centres of the north of England. Pop. (1921) 90,800.

Rochefort (rosh-för), Henri (Victor Henri, Marquis de Rochefort-Luçay), French journalist, dramatist, and politician, born in Paris 1831, died 1913. From his seat in the Chamber of Deputies, and in his newspapers, *La Lanterne*, *La Marseillaise*, and *L'Intransigeant*, he made vigorous attacks on successive Governments.

Rochefort, or **Rochefort-sur-Mer**, a strongly fortified seaport and naval arsenal of France, in the department of Charente-Inférieure, on the Charente, about 9 miles above its mouth. There are foundries, engineering-shops, and storehouses. There is a large naval hospital. The town has a good trade in colonial produce, wine, brandy, grain, salt, cattle, and dairy produce. Pop. 35,000.

Rochelle (ro-shell), La, a fortified seaport-town of France, capital of the department of Charante-Inférieure, on the Atlantic, protected by the Islands of Oléron and Ré. The chief buildings are the cathedral, town hall, and courts of justice. The harbour of La Pallice is one of the best on the west coast of France. La Rochelle has a trade in wines, brandies, and colonial produce. Its industries include briquettes and chemicals, petroleum-refining, and shipbuilding. In the religious wars it was long a Protestant stronghold. It stood an eight months' siege in 1572, but was forced to surrender by famine after three months in 1628. Pop. 36,370.

Rochelle Salts is the double tartrate of sodium and potassium. It has a taste like common salt, and occurs in large colourless crystals. In small doses it acts as a diuretic, and in large doses as a purgative.

Roche-moutonnées (rosh-mō-ton-ā), the name given by De Saussure to the rounded and smoothed humps of rock occurring in the beds of ancient glaciers. They have received their form and smoothness from the action of glaciers containing strong abrading material.

Rochester, John Wilmot, Earl of, a witty and profligate nobleman of the court of Charles II, was born in Oxfordshire in 1647 or 1648, died in 1680. He was educated at Wadham College, and succeeded to the title and estates in 1659. He served in the fleet under Lord Sandwich, and

distinguished himself at the attack on Bergen. On his return to England he became the personal friend and favourite of the king. His constitution gave way under his habits of drunkenness and debauchery, and he died at the age of thirty-two. His poetical works consist of satires, love-songs, and drinking-songs, many of them gems of wit and fancy, and many of them daringly immoral.

Rochester, a city, municipal borough, and river-port of England, in the county of Kent, on the Medway adjoining Chatham; served by the South-Eastern & Chatham Railway. It consists of Rochester proper, on the right bank of the river, and of Strood and part of Frindsbury parish on the left bank, communication being kept up by an iron swing-bridge. Rochester consists principally of one spacious street, which traverses it in a south-south-east direction towards Chatham, and of a number of minor streets. The cathedral, founded in A.D. 604, belongs to various periods, and was largely restored during last century. The industries include shipbuilding, agricultural implements, traction-engines, oil-cake, and cement. Rochester imports paper-making materials and timber, and exports cement. Many of the inhabitants are employed in the Royal Dockyard at Chatham. Pop. (1921), 31,260.

Rochester, a city of New York, United States, the county seat of Monroe county, on the Genesee, 7 miles above its entrance into Lake Ontario; served by the Erie Canal, which crosses the river by a splendid aqueduct; and by the Erie, Lehigh Valley, West Shore, and Buffalo Railways; by two divisions each of the Pennsylvania and Rochester & Pittsburg Railways; and by five divisions of the New York Central & Hudson River Railway. The prosperity of Rochester is partly due to the immense water-power furnished by the falls of the Genesee, which within the city limits makes a descent of 268 feet, one of the falls having a height of 96 feet. This power is employed in driving enormous flour-mills. Rochester is one of the first cities of the world in the manufacture of photographic and optical goods; it is the focus of enormous manufactories of the Eastman Kodak Company, and of the Bausch & Lomb Optical Company, who make lenses, telescopes, field-glasses, &c. Lubricating oil is also refined on a large scale. Pop. (1920), 295,750. —Cf. W. F. Peck, *History of Rochester and Monroe County* (2 vols., Chicago).

Among other Rochesters in the United States are: (1) *Rochester*, city of New Hampshire, in Strafford county, on the Cochecho and Salmon Falls; served by four lines of the Boston & Maine Railway. Pop. (1921), 9700. (2) *Rochester*, a city of Minnesota, county seat of Olmsted county, on the Zumbro; served by the Chicago Great Western and the Chicago & North-Western Railways. Pop. 10,000.

Roche-sur-Yon (rosh-sûr-yon), La, formerly **Napoléon Vendée** and **Bourbon Vendée**, a

town of France, capital of the department of Vendée, on the Yon, 49 miles south of Nantes. It was made the capital of the department by Napoleon I in 1807, being then a mere village. Pop. (1911), 14,885.

Rockall, an islet of the Atlantic Ocean, 240 miles from the nearest point on the Irish coast, 290 miles from Scotland, and 170 miles from St. Kilda. It is about 250 feet in circumference at its base, and about 70 feet in height, and represents the last fragment of the founded portion of the ancient continent of Arctis.

At a radius of 2½ miles from the rock the depths are from 40 to 70 fathoms; but within that area two other small rocks rise nearly to the surface of the sea. Haslewood Rock is a small half-tide detached rock, 1½ cables from Rockall, and Helen's Reef, 1½ miles from it, is covered by about 6 feet of water at low tide. Of three specimens of rock obtained from Rockall, two were found to be augite granite with apatite, magnetite, arfvedsonite, and a blue soda-amphibole; the third was a dyke rock.

Rockefeller, John Davison, American capitalist and philanthropist, born 1839. In 1870 the two Rockefellers, Andrews, and two men named Flagler and Harkness respectively, formed between them the Standard Oil Company, John D. Rockefeller being president. This combine gradually smashed all opposition in the American oil industry, and although it came in for much criticism during the anti-trust movement, the business brought immense wealth to the promoters. John D. Rockefeller retired in 1895, the wealthiest man in the world. An enthusiastic follower of the Baptist faith, he subsequently devoted himself completely to philanthropic work, and it is estimated that his gifts exceed \$500,000,000.

Rocket (*Brassica eruca*), a cruciferous plant of the cabbage genus growing wild in many parts of Europe. It has a strong odour and pungent taste, but is used by the Italians for salads. The term rocket is also applied to the dame's violet (*Hesperis matronalis*) and to species of other genera belonging to the ord. Cruciferae.

Rocket, a projectile consisting of an iron cylinder filled with an inflammable composition, the reaction of the gases produced by the combustion of which, pressing on the head of the rocket, serves to propel it through the air. The Congreve rocket was used in the British army up to 1860, and the Hale rocket to 1885. Rockets are still used for signalling and for pyrotechnic displays (see *Fireworks*), but their most important application is in the *rocket apparatus* for saving life at sea, by means of which a rope is thrown either from a ship in distress to the shore, or from the shore to the ship, generally the latter. The most reliable missiles are those discharged from a mortar or gun by gunpowder, and have a line attached to them. The *life-mortar* of Captain Manby, invented in 1807, is practically still in use. His missile was a shot with curved barbs,

resembling the flukes of an anchor or grapnel, to grapple the rigging or the bulwarks of a ship. An ingenious rocket-apparatus is Rogers's life-anchor, which consists of a three-fluked anchor, 12 lb. in weight, having the flukes so hinged that they pack closely together. When the anchor has been shot out from a mortar to a distance of 100 or 200 yards, the flukes open and fasten to the beach or to a ship, thus establishing communication between the two for dragging boats or men ashore. The sling life-buoy is employed in conjunction with the rocket apparatus, after communication has been established by a rope from the shore to the vessel. It consists of a circular cork life-buoy, having a pair of canvas breeches attached to it. The legs of the occupant protrude below the breeches, while his armpits rest on the buoy. The shipwrecked are by this means brought to the shore one by one, the buoy being drawn backwards and forwards by means of a travelling block. Or the life-car, a sort of covered boat, may be used to convey the men ashore. In Britain the Merchant Shipping Act of 1854 put the management of the life-rocket apparatus under the Board of Trade. There are numerous stations. Some of these are provided with mortars only, some with rockets only, and the rest with both mortars and rockets. All are supported by annual parliamentary grants, and contributions from the Mercantile Marine Fund.

Rock-fish, or Black Goby (*Gobius niger*), a British fish belonging to the family of the gobies. This fish is found chiefly on rocky coasts, and inhabits the deeper rock-pools left after the receding tide. Some of the wrasses are also occasionally known by the name of 'rock-fishes', as are also American fishes of the genus *Scorpena*. See *Bass*.

Rockford, a city of Illinois, United States, the county seat of Winnebago county, on the Rock River; served by the Chicago, Milwaukee, & St. Paul, the Illinois Central, Chicago, Burlington, & Quincy, and other steam and electric railways. It has abundant water-power, woollen- and cotton-factories, iron-foundries, agricultural machine and implement factories, and wagon- and carriage-factories. Pop. (1920), 65,651.

Rockhampton, a town of Central Queensland, on the Fitzroy River; served by the Central Queensland Railway, for which it is the terminus. It is connected with North Rockhampton by a suspension bridge. Port Alma, at the mouth of the Fitzroy, is a fine natural harbour, where ocean-going steamers can load or discharge their cargoes, but vessels of 1000 tons come up to Rockhampton. The Mount Morgan gold-fields are in the vicinity, and there are also coal-mines. The meat-packing industry is important. Pop. 20,900.

Rock Island, a city of Illinois, United States,

on the Mississippi; served by the Chicago, Milwaukee, & St. Paul, Chicago, Rock Island, & Pacific, and other railways. It is a great centre of railway and river traffic, and is connected with Rock Island and with Davenport (Iowa) on the opposite side of the river by a railway and general traffic bridge. Pop. (1920), 35,177.

Rockland, a city of Maine, United States, on Penobscot Bay; served by a branch of the Maine Central Railway. Shipbuilding is an important industry. Pop. 9000.

Another Rockland is a township of Plymouth county, Massachusetts; served by the New York, New Haven, & Hartford Railway, and by an electric-traction line. Pop. 8000.

Rock River, a river of the United States, which rises in Wisconsin, 50 miles west of Lake Michigan, and falls into the Mississippi 2 miles below Rock Island City. Length, 330 miles, about 225 of which are navigable by small steamboats.

Rock-salt, mineral sodium chloride, crystallizing in the cubic system, usually as cubes, and often occurring in massive beds 100 feet or more in thickness. It is soluble in water, and is commonly a product of the drying-up of ancient lakes, and is forming extensively in the Dead Sea and the Great Salt Lake of Utah at the present day. The beds are in many cases excavated by mining, huge hollow halls being left without pillars, owing to the stability of the walls. A roof of salt is left above, which is ultimately utilized by flooding the mine and pumping out the brine, an operation that naturally leads to subsidences of the surface. The salt of the plains of Northern India has accumulated from material borne by winds from the Indian Ocean. See *Salt*.

Rock-scorpion (*Buthus afer*), a species of scorpion found in Africa, averaging about 6 inches in length. The bite of this animal, although not absolutely fatal, is yet considered to be dangerous.

Rock-snake, a name given to certain non-venomous African snakes (species of Python), attaining a length of 15 feet. Like the boas, a rock-snake conceals itself in some situation coiled round some fixed object, whence it can readily and surely fasten on its prey, which it crushes among its muscular folds.

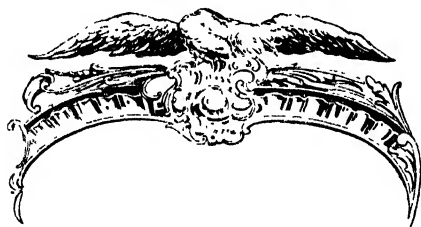
Rock-soap, a mineral of pitch-black or bluish-black colour, having a somewhat greasy feel and adhering strongly to the tongue. It is used for crayons and for washing cloth. It is a hydrated silicate of alumina, resembling bole, with water 20 per cent or so as against 14 per cent in kaolin; it occurs in the igneous rocks of Skye and Antrim, and in Poland.

Rocky Mountain Goat (*Haploceros montanus*), an animal inhabiting the Rocky Mountains and generally living among the most inaccessible heights. It has long white hair, and jet-black horns curving backwards.

Rocky Mountains, a name indefinitely given to the whole of the extensive system of mountains which covers a great portion of the western half of North America, but more properly applied to the eastern border of this mountain region, commencing in New Mexico in about 32° 30' N. lat., and extending throughout the continent to the Polar Sea; terminating west of the Mackenzie River in 69° N. lat., 135° W. long. The Rocky Mountains in the United States are divided into two parts in Southern Wyoming by a tract of elevated plateaus. The chief groups of the southern half are the Front or Colorado Range, which in Wyoming has a mean elevation of 9000 feet (at Evans Pass, where it is crossed by the Union Pacific Railway, 8269 feet). In Colorado it increases to a mean height of 13,000 feet, its highest points being Gray's Peak (14,341 feet), Long's Peak (14,271 feet), and Pike's Peak (14,147 feet). The Sawatch Range, south of the Arkansas River, has its highest peak in Mount Harvard (14,375 feet), with passes at an elevation of from 12,000 to 13,000 feet. The 'Parks' of Colorado are high mountain valleys, known as North, Middle, South, and San Luis Parks, with an elevation of from 6000 to 10,000 feet, surrounded by ranges 3000 to 4000 feet higher. The west border of the San Luis Park is formed by the San Juan Range with at least a dozen peaks over 14,000 feet, and between one and two hundred above 13,000 feet. On the north-eastern side this park is bounded by the Sangre de Cristo Range, in which is Blanca Peak (14,464 feet). The Uinta Range, directly west of North Park, has several points above 13,000 feet; and the Wasatch Range, which forms the western limit of the southern division of the Rocky Mountains, rises to a height of 12,000 feet just east of Salt Lake City. The northern division of the Rocky Mountains, with the exception of the Wind River Range and the Yellowstone region, is lower and has less impressive scenery than the southern. In Idaho and Montana the groups are more irregular in outline than in the south, and the division into ranges more uncertain. Of these the Bitter Root Mountains in part of their course form the divide between the Missouri and the Columbia. There two ranges reach altitudes of upwards of 9000 feet, and are crossed by a number of passes at elevations of from 5500 to 6500 feet. The Northern Pacific Railway crosses at Mullan's Pass (5548 feet) through a tunnel 3850 feet long. The Crazy Mountains, north of the Yellowstone, reach a height of 11,000 feet; other groups are the Big Horn Mountains and the Black Hills, whose highest point is Mount Harvey (9700 feet). The highest peaks in the Canadian Rocky Mountains proper are Robson Peak (13,700 feet) and Athabasca (13,500). Formerly the Canadian Rockies were regarded as culminating in Mount Brown, to

which a height of 16,000 feet was assigned. Mount Logan (19,500) and Mount St. Elias (18,000), on or near the Alaska frontier, do not properly belong to the range. The Rocky Mountains contain some of the finest scenery in the world, and are especially rich in deposits of gold, silver, iron, and copper.—Cf. E. Suess, *The Face of the Earth* (English translation by Hertha Sollas, vol. i, part ii). This deals exhaustively with the Rockies from a physiographical standpoint.

Roco'co (Fr. *rocaille*, rockwork, from *roche*, rock), a name given to a phase of the Renaissance prevailing in France and other countries of Central Europe during the seventeenth and first half of the eighteenth centuries. It is a debased variety of the Louis-Quatorze style of ornament, proceeding from it through the degeneracy of the Louis-Quinze. Rococo is generally a meaning-



Rococo Ornament

less assemblage of scrolls and crimped conventional shell-work, wrought into all sorts of irregular and indescribable forms, without individuality and without expression. An example of the Rococo style in architecture is the Zwinger Palace, Dresden.

Rocroi, or **Rocroy** (rok-rwà), a small fortified town of France, in the department of Ardennes, near the Belgian frontier, celebrated for the victory gained (1643) by the Duc d'Enghien (afterwards the great Condé) over the Spaniards. Pop. 2900.

Roden'tia, or **Rodents**, an order of mammalia, comprising the gnawing animals, such as rats, mice, squirrels, rabbits, &c. They are distinguished by the following characteristics: the teeth are limited to incisors, premolars, and molars, canines being entirely absent; the premolars and molars have tuberculated or flattish crowns, and are especially adapted for the attrition of food; the incisors are long, and spring from permanent pulps, thus being continually reproduced and shoved outwards from their bases. In the typical species the outer faces of the incisors are covered with hard enamel, but not the inner ones, hence the latter are soft and wear away faster than the anterior surfaces, thus keeping a sharp bevelled edge on the teeth. The digits are generally four or five in number, and are provided with claws. The intestine is long,

and the cæcum generally large. The brain is almost destitute of convolutions. The eyes are placed laterally. The rodentia are divided into two main divisions or sub-orders, viz. *Simplicidentata*, represented by mice, rats, squirrels, marmots, beavers, porcupines, &c., having the incisors strictly limited to two in each jaw; and *Duplicidentata* or *Lagomorpha*, comprehending hares and rabbits, distinguished by four incisors in the upper jaw and two in the lower.

Roderick, last of the Visigoth kings of Spain. On the deposition of King Witiza in A.D. 710 he was elevated to the throne. Shortly after his reign began, a conspiracy was formed against him by the sons of Witiza and others, including Count Julian, Governor of Ceuta, who invited Musa, the leader of the Moors in North Africa, to assist them. Roderick met them at Xeres de la Frontera, where he was completely defeated with heavy loss, being killed in the battle. His fate is the theme of several old Spanish romances, and of poems by Scott and Southey.

Rodez, or **Rhodes** (rô-däs), a town of Southern France, capital of the department of Aveyron, on a height above the Aveyron, 85 miles northwest of Montpellier. Pop. 15,400.

Rodin (rô-dan), Auguste, French sculptor, born in Paris in 1840, died there 1917. A pupil of Barye, he afterwards worked from 1871 to 1877 in the Atelier Carrier-Belleuse in Brussels. Returning to Paris, he contributed for several years to the Salon, his works including busts of several men of note, a monument to Victor Hugo, *Contemplation*, *The Kiss*, and others. For twenty years he worked on an elaborate composition entitled *The Portal of Hell*; and other notable works include: *The Burgesses of Calais*, a replica of which is in the Victoria Gardens, Westminster; a monument to Claude Lorrain; and *Le Penseur*. Rodin's works are characterized by very strong individuality and disregard for convention, and have been much criticized for their realism, which, however, is selective and expressive rather than imitative. He has exercised a very considerable influence on modern sculpture. His sculpture was collected and exhibited at the Paris exhibition of 1900; and just before his death he presented a representative group of work to the Victoria and Albert Museum.

Rodney, George Brydges, Baron Rodney, British sailor, born in 1719 at Walton-upon-Thames, died 23rd May, 1792. He became a lieutenant in the navy in 1739, first obtained a ship in 1742, and in 1749 went to Newfoundland as Governor. On his return in 1752 he was elected member of Parliament for Saltash. In 1759, having been promoted to the rank of admiral, he bombarded Havre de Grâce in face of the French fleet. In 1762 he reduced Martinique, and on his return was rewarded with a baronetcy. In 1779

he was appointed to the chief command on the West India station, and in Jan., 1780, completely defeated a Spanish fleet under Langara off Cape St. Vincent. He sailed for the West Indies again in 1781, and on 12th April, 1782, obtained a decisive victory over the French fleet under De Grasse. A barony and a pension of £2000 were bestowed upon him for his services.—Cf. G. B. Mundy, *Life and Correspondence of Admiral Lord Rodney*.

Rodos'to (Turk. *Tekir Dag*; Mod. Gr. *Raidestos*), a town of Thrace, the ancient *Rhædestus* or *Bisanthe*. It stands at the foot of the Tekfur-Dagh (500–845 feet altitude), and is the only considerable port in Thrace. There is no harbour, but an open roadstead provided with five piers, and exposed to east and south-easterly winds, offers a fair anchorage. Before the European War the export of cereals from Rodosto to Constantinople and Europe in general amounted to £300,000 in value per annum, general merchandise being imported to a total annual value of over £700,000. Pop. (1920), 19,040.

Under the *ancien régime* Rodosto was a Sanjak in the vilayet of Adrianople, and was divided into the four *kazas* of Rodosto, Chorlu, Malgara, and Hairobolu, having populations of 46,650, 25,500, 36,250, and 27,100 respectively. Among these the Greeks numbered 25,380, 9500, 13,900, and 4000 respectively. After the European War there was a Greek department (pop. 1920, 143,800), with Raidestos as capital, but this arrangement was nullified by Mustafa Kemal's 1922 campaign.

Rodriguez (rod-rē'gez), an island in the Indian Ocean, one of the Mascarenes, 344 miles east of Mauritius, of which British colony it is a dependency; area, about 44 sq. miles. The chief town is Mathurin. The climate is healthy, but there are frequent hurricanes. Exports include maize, beans, cattle, fish, poultry, and fruit. The island was seized by the British in 1810. Pop. about 6700.

Roebuck, or **Roe-deer** (*Capreolus caprea*), a European deer of small size, the adult measuring about 2 feet at the shoulders. The horns or antlers are small, and provided with three short branches only. The general body-colour is brown, whitish beneath. These animals inhabit mountainous and wooded districts. When irritated or alarmed, they may prove very dangerous adversaries.

Roermond (rōr'mond), a town of Holland, in the province of Limburg, at the confluence of the Roer and Maas. It has a large and beautiful parish church, and an old abbey church, the Munsterkerk, built in the thirteenth century. Cloth and tobacco are traded. Pop. 14,000.

Roestone, a variety of oolitic limestone composed of small rounded particles like fish roe.

Rogation Days (Lat. *rogatio*, a request, from *rogare*, to ask), the Monday, Tuesday, and Wednesday before Holy Thursday or Ascension Day, so called from the supplications or litanies which are appointed in the Roman Catholic Church to

be sung or recited in public procession by the clergy and people. In England, after the Reformation, this practice was discontinued, but it survives in the custom (observed in some places) of perambulating the parish boundaries. *Gang days* (A.-S. *gangan*, to walk) is an old name for Rogation Days.—Cf. R. Chambers, *The Book of Days*.

Roger I, Count of Sicily, one of the numerous sons of Tancred de Hauteville, a Norman baron in France, born about 1081, died in 1101. He joined his brother Robert Guiscard in Apulia in 1057, and assisted him to found the Kingdom of the Two Sicilies. He captured Messina in 1061, Palermo in 1072, and Agrigentum in 1087. Upon the death of Robert in 1085 Southern Italy as well as Sicily came into Roger's hands.

Roger II, King of Sicily, second son of the above, born in 1093, died 1154. When he came of age, Roger executed his task of governing Sicily with great ability and courage, and his sway was gradually extended over a great part of Southern Italy. Although the German Emperor Lothaire and the Greek Emperor Manuel I were leagued against him, and Innocent II excommunicated him, he defended himself with success and defeated the Pope's forces at Galluzzo, taking Innocent prisoner. Peace was made, the Pope annulled all excommunication against Roger, and recognized his title of king. Roger afterwards fought with success against the Greeks, took Corfu, and gained part of the north coast of Africa. He was succeeded by a son and a grandson.

Roger of Wendover, an early English chronicler, of whom little is known, except that he was a monk of St. Albans, afterwards prior of Belvoir, and died at St. Albans Abbey in 1236. He was the writer of the work entitled *Flores Historiarum*. Part of it is published in the *Rolls Series* (3 vols., 1886–9).

Rogers, Benjamin Bickley, English classical scholar, was born in 1828, and died in 1919. He was educated at Wadham College, Oxford, and obtained a first class in Literæ Humaniores in 1851. He held a fellowship at Wadham from 1852 until his marriage in 1861. He was called to the Bar by Lincoln's Inn in 1856, and after acquiring a great reputation was obliged to retire owing to deafness; he afterwards devoted himself to literature. He produced a complete edition of Aristophanes, which is the best edition of the great comic poet in English, and which is one of the best editions ever published of any ancient classic. Rogers began his translation of Aristophanes with a version of the *Clouds*, written while he was still an undergraduate and published in 1852, and concluded his labours with an elaborate edition of the same play published in 1915. Rogers's edition is a monument of sound

scholarship of the best kind, scholarship which is reinforced by a knowledge of men and of general literature. His introductions and notes are models of thoroughness and soundness, and he is so thoroughly impregnated with the spirit of Aristophanes that there is wit and humour even in his critical apparatus. His verse translation is at once spirited and faithful, and in his renderings of the lyrics he is masterly. Not only is his translation unmatched, but his contribution to the textual criticism of the plays is of the greatest value. Plato said that "The Graces seeking a shrine which should not fall found the soul of Aristophanes", and the "sweete wittie soule" of Aristophanes lives in his English translator and interpreter.

Rogers, Samuel, English poet, born at Stoke-Newington, London, in 1763, died in 1855. His father was a leading member of a Dissenting congregation, and a banker by profession. After completing his attendance at school, young Rogers entered the banking establishment as a clerk, but his favourite pursuits were poetry and literature. His first appearance before the public was in 1786, when he gave to the world his *Ode to Superstition, and other Poems. The Pleasures of Memory*, with which his name is principally identified, appeared in 1792, and *An Epistle to a Friend* in 1798. In 1810 he published *The Voyage of Columbus*, a fragment; in 1814, *Jacqueline*, a tale; in 1819, *Human Life*; and in 1822, *Italy*, a descriptive poem in blank verse. The last-named poem was saved from oblivion by the fact that the sumptuous edition of 1830 contained engravings by J. M. W. Turner. Rogers was, until within a few years of his death, a man of extremely active habits, and was noted for his benevolence. He formed a remarkable collection of works of art, &c., and issued sumptuous editions of his own works, with engravings on steel from drawings by Turner and Stothard. A volume of his *Table Talk* was published by his friend Alexander Dyce (London, 1856).—Cf. R. E. Roberts, *S. Rogers and his Circle*.

Rogers, Woodes, British sea-captain, Governor of the Bahamas, and commander of the privateers *Duke* and *Duchess*, operating against the Spaniards. With William Dampier as master of the *Duke*, and a well-assorted crew, Rogers left King Road on 2nd Aug., 1708, and eventually rounded the Horn (Jan., 1709), made Juan Fernandez, and found Alexander Selkirk (Robinson Crusoe), who, as an old friend of Dampier, became a mate of the *Duke*. The expedition captured and sacked the town of Guayaquil, crossed the Pacific, and rounded the Cape (Dec., 1710), returning to England on 1st Oct., 1711. Rogers was now sent as Governor to the Bahamas, then infested with pirates under the leadership of Vane and Edward Teach, and, although he

could only muster three hundred men, the new Governor hanged ten of the pirates, on his own responsibility. For this he was superseded, but was reinstated in Oct., 1728, and died at Nassau in July, 1732.

Rohan (rô-ân), Henri, Duc de, French soldier and Protestant leader, born in 1579, died in 1638. In his sixteenth year he joined the court of Henri IV, and after the death of the latter in 1610 became chief of the Huguenots. After the fall of Rochelle (1628), and the peace of 1629, Rohan withdrew from France, and in exile wrote his *Mémoires sur les choses advenues en France depuis la mort de Henri IV* (Paris, 1630). He commanded the Venetian troops against Austria until the Peace of Cherasco in 1631. In 1638 he joined the Protestant army on the Rhine, and died of wounds received at the battle of Rheinfelden. He was the author of *Mémoires sur la guerre de la Vallée* (1638), *Les Intérêts des princes* (1649), and *Discours politiques* (1693).

Rohan-Guéméné, Louis René Edouard, Prince de, Cardinal-archbishop of Strasbourg, born in 1734 at Paris, died 1803. In 1772 he went as Ambassador to the court of Vienna. Rohan derives his notoriety, however, chiefly from the affair of the necklace. (See *La Motte*.) He was then Grand Almoner of France, and being thrown into the Bastille, continued in prison more than a year, when he was acquitted and released by the Parliament of Paris, Aug., 1786.

Rohilkhand, or **Rohilkund**, a division of the United Provinces of India. Area, 12,800 sq. miles; pop. 5,650,000. The surface is a triangular plain enclosed by the Himalaya (north), the Ganges (south-west), and Oudh (east), and with a gradual southward slope, in which direction its principal streams, the Ramganga, Deoha, and others, flow to the Ganges. It takes its name from the Rohillas, an Afghan tribe, who gained possession of it early in the eighteenth century. It is subdivided into the districts Bijnor, Muradabad, Budaon, Bareilly, Pilibhit, and Shahjahanpur, and it encloses the native principality of Rampur.

Rohtak, a district and town of the Punjab, India. The district is in the Delhi division, and lies on the borders of Rájputána; area, 1980 sq. miles. Wheat in spring, and millet in autumn are the chief crops. Pop. 630,000. The town is the head-quarters of the district; served by the Southern Punjab Railway, which also serves the district. Pop. 20,300.

Roland, or **Orlando**, a hero of the romances of chivalry, and one of the paladins of Charlemagne, of whom he is represented as the nephew. His character is that of a brave, unsuspicious, and loyal warrior, but somewhat simple in his disposition. According to the *Song of Roland*, an old French epic, he was killed at the battle of

Roncesvalles (q.v.) after a desperate struggle with the Saracens, who had attacked Charlemagne's rearguard. The celebrated romantic epics of Boiardo (*Orlando Innamorato*) and Ariosto (*Orlando Furioso*) relate to Roland and his exploits.

Rolland, Romain, French author, born at Clamecy, Nièvre, in old Burgundy, 29th Jan., 1866. He was educated at the École Normale Supérieure, and became professor of the history of music, first at the Normal School, and in 1903 at the Sorbonne. Rolland's thesis, *Les Origines du théâtre lyrique moderne*, was crowned by the Académie Française. Devoting himself to literature, he wrote a number of plays, biographies, and works of criticism, such as: *Le Triomphe de la raison* (1898), *Danton* (1901), *Le 14 juillet* (1902), *Beethoven* (1903), *Vie de Michel-Ange* (1907), *Musiciens d'autrefois* (1908), *Musiciens d'aujourd'hui* (1908), *Le Théâtre de la révolution* (1909), *L'Humble vie héroïque* (1912), and *Les Maîtres de la musique* (1912). When the Dreyfus case divided France against itself, and passion ran high, Rolland, with his innate sense of justice, joined his friend Peguy in fighting for the innocent victim of clericalism and Anti-Semitism. He published a dramatic parable entitled *Les Loups*, which was highly appreciated by Zola and other distinguished Dreyfusards. In the meantime Rolland was working on his masterpiece, *Jean Christophe* (1904-12), a work which has made him famous. *Jean Christophe* is not a novel in the strictest sense of the word. It is the story of a young musician of genius who is voicing the author's views on life. The hero is a lonely fighter, but also a conqueror who "knows life and loves it". *Jean Christophe*, in which Rolland "embodies the living faith of his generation", a generation that is about to pass, has been rightly defined as an "educational romance, like *Wilhelm Meister*". It is, however, also a *comédie humaine* in Balzac's sense, and an *histoire contemporaine* in Anatole France's sense. It is at once a record of our time, and a message. When the European War broke out, Rolland was already famous, and he created a sensation when on 22nd Sept., 1914, he published his essay *Au-dessus de la mêlée* in the *Journal de Genève*. He continued a pacifist all through the war. In 1915 he was awarded the Nobel prize for literature. —Cf. Stefan Zweig, *Romain Rolland: the Man and his Work*.

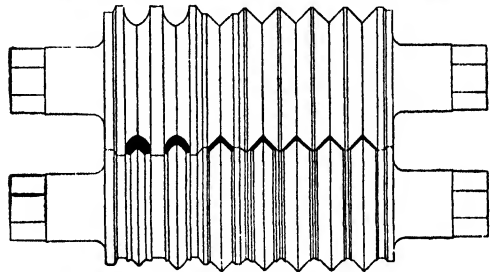
Roller, a name of about a score of brightly coloured Old World birds, generally of small size, and constituting a family (Coraciidae) of the order Coraciiformes. The common roller (*Coracias*

garrulus), an occasional visitor to Great Britain, ranges through temperate Europe to Northern Africa and Northern India. In size the roller



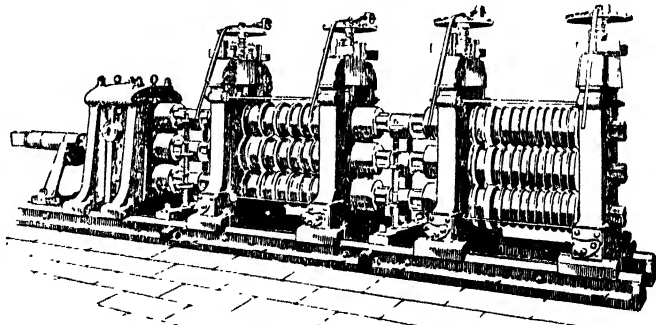
Common Roller (*Coracias garrulus*)

averages the common jay. Its voice is noisy and harsh. The name has reference to the habit of rolling over during flight, like a tumbler pigeon.



Pair of Finishing Rolls for Rolling Angles

Rolling-mill, the machines used to reduce billets of metal, usually mild steel, to the form of plates, bars, or sections. These mills are pro-



Rolling-mill fitted with Rolls for Rolling Rounds. By courtesy of Messrs. Thomas Perry & Sons, Ltd.

vided with cylindrical rolls, which, when they are to be used for the rolling of plates, are finished with flat sides, but have grooves cut in them to produce the sections desired, if they

are to be used for the manufacture of structural steel. The rolls are made of cast iron, either ordinary or chilled, or of cast steel. The operations of rolling are begun when the billet is at a white heat, and are continued until the metal is dull red. The process of producing any particular section is carried out in a number of operations, the approach to the size required being made in a series of steps.

In plate rolling the metal is sent through the rolls in a series of runs, with a reduction in thickness and a consequent increase in the other dimensions at each passage. The effect of the

important historical documents. The publications were started in 1857 by Sir John Romilly, and over 250 volumes have already appeared.

Romagna (rō-mān'yā), formerly the north-eastern portion of the Papal States, embracing the provinces of Ferrara, Bologna, Ravenna, and Forlì, all in the *compartimento* of Emilia. Romagna was joined to Piedmont in 1860.

Roman Architecture, the style of building practised by the ancient Romans. Derived on the one hand from the Etruscans, and on the other from the Greeks, the fusion ultimately resulted in an independent style. Its essential



Roman Architecture—Reconstruction of the Great Hall in the Baths of Caracalla

rolling on the metal is well seen in microscopic examination of a part cut from the plate. The more or less regular structure in all directions of the cast steel is replaced by a decided run of the 'fibre' in the direction of rolling. The steel-makers specify limits of sizes to which they roll plates, and where large structures have to be built up of plates, a number of them are riveted together with butt or lap joints (see *Rivet*).

In the production of structural steel the first part of the process is usually the formation of bars of rectangular section with the edges rounded off in what is termed a *cogging* mill, or diamond shaped with either curved sides, in a *gothic* mill, or flat sides in a *diamond* mill. Such bars are later passed through the two section mills, known as roughing- and finishing-mills.

Rolls Series, the series of English publications issuing from the Record Office under the control of the Master of the Rolls. It comprises most of the chief English chronicles and many highly

characteristics are, the employment of the Tuscan and the Composite order, and the introduction and free use of the semicircular arch and arcade, together with the use of rounded and prominent mouldings, often profusely decorated. In Roman architecture the great feature is the employment of the arch as well as the lintel, while Greek architecture employs the lintel only. It produced various constructions, unknown to Greek art, such as amphitheatres, circuses, aqueducts, bridges, baths, triumphal arches, &c. It has thus been of vastly greater practical utility than the Greek, and is bold and imposing in appearance. The column as a support, being no longer exclusively a necessity, was often of a purely decorative character. The arch was freely used internally as well as externally, and became an important feature of interiors. The Roman temples, as a rule, from the similarity of the theogony to that of the Greeks, were disposed after the Greek form, but a purely Roman type

is seen in the circular temples such as the Pantheon at Rome, the temple of the Sibyl at Tivoli, the temple of Vesta at Rome, &c. This style of architecture was introduced by the Romans into all their colonies and provinces—vast existing remains evidencing the solid character of the buildings. It reached its highest stage during the reign of Augustus (27 B.C.), and after the translation of the seat of empire to Byzantium it degenerated and ultimately gave place to a debased style.

Roman Catholic Church, that society of Christians which acknowledges the Bishop of Rome as its visible head. The foundation of the Christian Church at Rome is uncertain, but St. Paul did not visit Rome until after he had written his *Epistle to the Romans*. The claim to supremacy on the part of the Bishop of Rome is based on the belief that our Lord conferred on Peter a primacy of jurisdiction; that that Apostle fixed his see at Rome; and that the Bishops of Rome, in unbroken succession from Peter, have succeeded to his prerogative of supremacy. The distinctive character of the Roman Church is the supremacy of the Papacy. Its doctrines are to be found in the Apostles' creed, the Nicene creed, the Athanasian, and that of Pius IV. The latter added the articles on transubstantiation, invocation of saints, and others which chiefly distinguish the Roman from other Christian communities. The dogmas of the immaculate conception of the Virgin Mary and Papal infallibility are recent additions. Roman Catholics believe that the Mass is the mystical sacrifice of the body and blood of Christ, that the body and blood are really present in the eucharist, and that under either kind Christ is received whole and entire. They also believe in purgatory, that the Virgin Mary and the saints are to be honoured and invoked, and that honour and veneration are to be given to their images. Seven sacraments are recognized, viz. baptism, confirmation, the holy eucharist, penance, extreme unction, holy orders, and matrimony. A hard-and-fast line in matters relating to the faith is drawn between what is of doctrine and what of discipline. Doctrine is what was taught by Christ and his disciples; discipline, different rules, laid down by the councils, for the government of the Church, the administration of sacraments, and the observances and practices of religion. Fasting and confession form part of the discipline. The clergy of the Church in the West are bound by a vow of celibacy implied in their ordination as subdeacons. The clergy of those Greek and Armenian Churches that are united in communion with the see of Rome may receive orders if married, but may not marry after ordination. Under the generic name of Roman Catholics are comprised

all Churches which recognize the supremacy of the Pope of Rome, including the United Greeks, Slavonians, Ruthenians, Syrians, Copts, and Armenians. The supreme council or senate of the Roman Church is the College of Cardinals, seventy in number, who are the advisers of the sovereign, and, on the death of the Pontiff, elect his successor. The total number of members of the Roman Catholic Church has been estimated at 272,860,000, about 5,704,200 being in Great Britain and Ireland, and 13,814,400 in the Empire. In India there are 1,900,200 Roman Catholics; in Canada, 3,270,000; in Ceylon, 340,000; in Australia, 1,000,000; in New Zealand, 152,000; and in the Union of South Africa, 91,000. In England and Wales there are 4 archiepiscopal and 13 episcopal sees; in Scotland, 2 archiepiscopal and 4 episcopal sees; in Ireland, 4 archiepiscopal and 24 episcopal sees; in the Empire, 38 archiepiscopal and 112 episcopal sees, with 54 vicarates and 9 prefectures. In Ireland there are 3830 priests serving 2573 parochial and district churches situated in 1116 parishes. England and Wales had (1921) 3970 priests serving 1932 congregations, and Scotland had 600 priests with 428 churches and stations. The United States has (1921) 17,580,000 Catholics, 16 archbishops, 93 bishops, 21,650 priests, 16,580 churches, &c., and 1,700,000 pupils in denominational schools. See also such articles as *Catholic Emancipation*; *Conception, Immaculate*; *Infallibility*; *Mass*; *Monasticism*; *Popes*; *Papacy*; *Papal States*; *Saints*; &c.

Romance. The word *romance* comes from *romanice*, a Latin adverb used by the Latin nations (French, Spanish, &c.) in the Middle Ages to mean 'in the vulgar tongue', i.e. in the popular *lingua romana*, as distinguished from *lingua latina* or correct Latin. Romance then became a noun, meaning the modern popular language derived from Latin; this usage was long preserved in Spain, where *traducido en romance Castellano* means 'translated into Spanish'. The next stage was that *romance* came to mean any book, but especially a story, written in the modern language. So that *Roman de Troie*, *Roman du Renart*, *Roman de la Rose*, might be fairly translated 'Troy Book', 'History of Reynard the Fox', 'The Book of the Rose'. But quite early in France, in the twelfth century at any rate, the name was applied most frequently to imaginative stories of adventure and sentiment. In France and Italy to-day the ordinary name for a novel, *roman*, *romanzo*, keeps much of the mediæval sense. In Spain a novel is *novela*, because in Spain *romance* came to have a special meaning, more or less that of the English and Scottish *ballad*. In France, while *roman* is kept for a prose story, *romance* may be used of a kind of song. Besides the various species of

romance, in different languages the word is also used in a general way for the sum of qualities to which the term 'romantic' may be applied—the whole World of Wonder, of the Faery, of visionary islands, and the Land East of the Sun and West of the Moon:

like a Lady of the Mere
Sole sitting by the shores of old Romance.
—Wordsworth.

In this way the word *romance* may be rightly used of many works of imagination not belonging to the Middle Ages, e.g. of the *Odyssey* and the *Æneid*. So that it is hard to say where romance may not be found. But the proper old application of the name to a large number of mediæval stories makes those stories the right subject for special description.

Mediæval romance flourishes best in the rhyming stories of a number of French authors in the twelfth and thirteenth centuries. The chief of these is Crestien de Troyes, whose romances of the *Knight of the Lion*, *Enid*, *Lancelot*, and *Percival* (the Story of the Grail) were widely read, translated, and adapted, so that Crestien may be taken not exactly as the first inventor, but as the chief founder of a school of fiction that was successful over the whole of Christendom. The fashion differed from an earlier mode of story-telling, and may be described through contrast with that which is commonly regarded as the epic poetry of France, in the *chansons de geste*, of which the *Song of Roland* is the chief. The difference is that the older sort of story dealt more in warfare and less in sentiment; it was also composed in rougher verse, and generally circulated through recitation by minstrels. Whereas the newer fashion which we name romance was practised by ambitious authors, proud of their elegant style, who meant their works not to be recited but to be read in the best society. The distinctive mark of romance, in this new school, was its concern with love and with refinements of amatory sentiment. This was usually combined with the interest of wonderful adventures, though sometimes, as, e.g., in the *Cligés* of Crestien and *Amadas et Ydoine* (a French romance written in England by an author whose name is lost), the purely sentimental interest is kept up without the adventures of chivalry. Romance really flourished on the two sources of interest: the passion of lovers and the dangers of adventure. Both were as old as the hills, or at any rate as the song of Lamech to Adah and Zillah; but it happened that in France in the twelfth century there were many causes at work to give freshness and variety to the oldest motives of story-telling. The sentiment was quickened and refined through the progress of lyric poetry in Langue d'Oc, the Provençal language of the Troubadours; while immense new treasures of adventure were

opened up for French authors in fresh readings of Virgil and Ovid, in acquaintance with Welsh and Breton legends and fairy-tales, and in importations of Oriental fables. The romantic school of the twelfth century shows the same characteristic tastes as were in vogue about 1800 in the several romantic schools of modern times—the taste for the extraordinary, both in emotion and in circumstances. The successful author of romance insists on the subtlety of his analysis and the charm of his language in expressing the mental distractions of his hero and heroine; he also will go anywhere to find new magic, new thrills of danger, new plots.

A great deal of mediæval romance comes from Greek indirectly, and directly from Latin. There was no pedantic difference in the twelfth century between classical and romantic. Among the most successful romances were the tales of Thebes and Troy. The *Roman d'Eneas* was a French paraphrase of the *Æneid*. Nothing of this sort is more remarkable than the life of Jason as it is told by the author of the *Roman de Troie*, who took the Argonauts on his way to introduce the story of the Trojan War. The story of Jason and Medea has been described by Andrew Lang (*A Far Travelled Tale*) and compared with a number of folk-lore variants. Jason is the young man of the fairy-tale who comes to the house of the wizard, the dangerous king, to win something precious which he has promised to bring home with him. He has three tasks set him to perform, each impossible, till the king's daughter comes and helps him with her magical art, and he carries off the Golden Fleece. There is no better fairy-tale anywhere, and the French author, Benoît de Saint Maur, gets full value out of it for his purpose. But he also gets more than the magic of fairy-tales. He found his story in Ovid's *Metamorphoses*, and Ovid's Medea is not exactly the princess of a fairy-story. Ovid knew Medea from Greek poems of the most accomplished sort. Ovid's Medea is a heroine of tragedy (he wrote a tragedy on the subject also, praised by Quintilian but now lost); through Ovid the eloquence of Greek tragedy passed into French mediæval romance. Mediæval romance derived much of its language of the heart in this way from the old Greek drama; the Greek heroines bequeath their passions and their eloquence to Yseult and Guinevere, and through them to the heroines of later stories, even to Clarissa Harlowe. The development of the modern novel can be traced back to the adaptations from Ovid in the old French *Troy Book*.

English Romance in the Middle Ages was very much dependent on French, but never till the time of Chaucer and Gower succeeded in touching the same kind of sentiment. To begin with, romances in English were not suited for 'the

quality'; the nobility and gentry had French romances; English rhymes were left to the common people, the audiences who listened to minstrels. But class distinctions were never absolute with regard to stories, and there is great variety among the English romances between 1200 and 1500. Some are connected with old English or Anglo-Danish heroic tradition; Havelock the Dane is thought to be the same as the Anlaf who fought at Brunanburh against King Alfred's grandson. One of the most popular, *Bevis of Hamtoun*, is connected with a French *chanson de geste*; the hero as Sir Bevis of Southampton, along with Sir Guy of Warwick, remained a favourite long after the close of the Middle Ages, and helped Bunyan in his *Pilgrim's Progress*. Many of the romances use a simple form of stanza; this was copied by Chaucer in his burlesque romance *Sir Thopas*, which brings out the weaknesses of the common form without any great discredit to the real though rather slender virtues of its minstrelsy. Besides the ordinary specimens of fiction, there are some romances distinguished by a definite ambition on the part of the author. *Sir Tristrem* (thirteenth century), first edited by Scott, is one of these. In the fourteenth century a great opening was given to authors with minds of their own by the revival of the old alliterative rhymeless verse, which somehow or other carried along with it a 'pride of port', so that the alliterative poems, good or less good, are all of them dignified; some of them are thoroughly original in spirit, though making use of old material: such are *Sir Gawain and the Grene Knight*, and the alliterative *Morte Arthur*, which Dr. George Neilson has shown to be an allegorical epic in honour of King Edward III. The alliterative verse lasts into the sixteenth century; its latest appearance is not in a romance, but in a poem on a contemporary battle, *Scotish Field*, that is, Flodden.

Among later types, the French heroic romances of the seventeenth century deserve particular mention on account of their success in England as well as France. 'Heroic' here means 'epic'; the famous romances of the *Grand Cyrus*, *Clelia*, *Cassandra*, were intended to be prose epics, more dignified therefore than ordinary stories. One effect of this is found in Fielding's description of his novels as comic epic poetry in prose. Later forms of romance belong to the history of the novel, and of poetry, in different languages. —BIBLIOGRAPHY: W. P. Ker, *Epic and Romance*, and *The Dark Ages*; G. Saintsbury, *The Flourishing of Romance and the Rise of Allegory*; J. Ritson, *Ancient English Metrical Romance*s; Weber, *Metrical Romances*; D. Laing, *Select Remains of the Ancient Popular Poetry of Scotland*, and *Early Scottish Metrical Tales*; Robson, *Three Early English Metrical Romances*.

Romance Languages. In the countries conquered by Rome the vernacular disappeared under the influence of the military conquest and the subsequent colonization. The language spoken by both soldiers and colonists (called Vulgar or Low Latin) differed from Classical Latin in many points of vocabulary, phonetics, morphology, and syntax. The Romance languages represent nothing but the state which Vulgar Latin reached after an evolution lasting over centuries. The Romance languages are: *Portuguese*, *Spanish*, *Provençal*, *French*, *Italian*, *Roumanian*, to which must be added certain dialects spoken in various parts of South-Eastern Switzerland and Tyrol, these constituting the *Rhæto-romanic* group. If we take a word like the Classical Latin *fidere* (to trust), we know that it became in Vulgar Latin *fidare*, and *fidare* gradually developed in the different Romance languages as follows: Spanish and Portuguese, *fiar*; Provençal, *fizar*; French, *fier*; Italian, *fidare*; Rhæto-romance, *fider*; similarly the Latin *gustare* (to taste) developed into Portuguese, Spanish, Provençal, *gostar*; French, *gouster* (Modern French, *goûter*); Italian, *gustare*; Roumanian, *gustă*; Rhæto-romance, *guster*. The unity presented by each of the Romance languages, both in their past and modern aspect, is more apparent than real; formerly each of them was constituted by a certain number of dialects, but under the influence of historical, literary, and social events one of them (for instance, Castilian in Spain, French of the Ile-de-France in France, &c.) became the official language in each of the Romance-speaking countries. It is important to note that from that standpoint two of the above-mentioned tongues (Provençal and Rhæto-romance) have totally disappeared. And nowadays in the same way, in spite of centralization, compulsory education, facility of communications, extension of the railway system, and military conscription, which tend to give uniformity and unity to a language, there are still to be found a great variety of *patois* in each Romance tongue. A sailor of Boulogne, for example, and a peasant of Cauterets speak the same official language (French) when addressing each other, but their *patois* are quite different. A very accurate and striking idea of that variety of *patois* may easily be acquired by a glance at the maps contained in the *Atlas linguistique de la France* by Gilliéron and Edmont. This continued vitality of the *patois* must be borne in mind if we are to understand the attempts made by some provincial writers to restore to their local vernaculars the literary splendour which they had long since lost. The most noteworthy effort in this direction is that of the *félibres*; they have revived the Provençal language, and the most celebrated of these poets of Southern France is Frédéric

Mistral (1830–1914), whose chief poem, *Mirèio*, is acknowledged as one of the world's literary masterpieces. Linguistic and geographical frontiers do not always coincide; in Italy, for instance, there remain a few enclaves where German, Greek, and Albanian are still spoken; in Spain Biscayan is spoken in Biscaya, Guipuscoa, and parts of Alava and Navarra; in France Celtic is to be found in part of Brittany; Biscayan in parts of Labourd, Lower Navarre, and Soule; and Germanic dialects in parts of Alsace and of the département du Nord. Romance languages have also been carried outside Europe. Italian and Spanish are used in the Argentine Republic; 20 million people speak Spanish in South America; Portuguese is spoken in different parts of India, Africa, and Brazil. 50,000 persons speak French in Louisiana, 10,000 in Nova Scotia, 2,500,000 in Canada, &c. In French Northern Africa French is becoming more and more widespread. Most of the Romance languages spoken outside Europe differ widely from those spoken in the mother-countries. Such is especially the case with French-Canadian.—BIBLIOGRAPHY: E. Bourciez, *Éléments de linguistique Romane*; C. H. Grandgent, *An Introduction to Vulgar Latin*; Gaston Paris, *Mélanges linguistiques*.

Roman Cement, a brown and quick-setting cement made from the clay-limestones or septaria found in the London clay-beds. The cement is prepared by roasting the raw material and afterwards grinding it to powder. This natural cement is very durable.

Romanes, George John, British biologist, born at Kingston, Canada, in 1848, died at Oxford in 1894. In 1867 he entered Gonville and Caius College, Cambridge, whence he graduated in 1870, afterwards devoting himself to the study of physiology, and becoming a friend and follower of Darwin. In 1891 he founded the Romanes lectureship at Oxford, whither he had migrated from London owing to ill-health. His works include: *Animal Intelligence* (1881); *Scientific Evidence of Organic Evolution* (Nature Series, 1882); *Mental Evolution in Animals* (1883); *Mental Evolution in Man* (1888); *Darwin and after Darwin* (1892–5); *Examination of Weismannism* (1893); *Mind and Motion, an Essay on Monism* (1895); and *Thoughts on Religion* (1895).

Romanesque Architecture, a general and rather vague term applied to the styles of architecture which prevailed in Western Europe from the fifth to the twelfth century. The Romanesque may be separated into two divisions: (a) the debased Roman, in use from the fifth to the eighth century; and (b) the later Romanesque of the eighth to the twelfth century, which comprises the Lombard, Rhenish or German, and

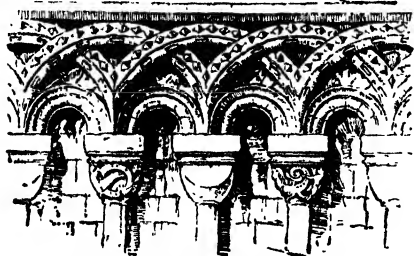
Norman styles. The former is characterized by a pretty close imitation of the features of Roman, with changes in the mode of their application and distribution; the latter, while based on Roman form, is Gothic in spirit, has a predominance of vertical lines, and introduces a number of new features and greatly modifies others. To the former belong especially churches of the basilica type (see *Basilica*) in various cities of Italy, as also a number of circular churches, and many of these buildings have a certain affinity to the Byzantine type of architecture. (See *Byzantine Art*.)



German Romanesque Architecture: The Minster, Bonn

The semicircular arch is used throughout the entire period, and the general expression of the buildings is rather severe. It assumes different phases in different countries. In Romanesque churches of the ninth and the eleventh century the prevailing features are: that in plan the upper limb of the cross is short and terminated by a semicircular or semioctagonal apse; the transepts frequently short, and often rounded externally; the walls very thick, without buttresses or with buttresses having very slight projection; the pillars thick, sometimes simply cylindrical or clustered in large masses, and either plain or with but simple decoration; the capitals of cushion form, sometimes plain, at others enriched with various ornaments peculiar to the style. Externally, roofs of moderate pitch; towers square or octagonal, low or of moderate elevation, and with terminations of pyramidal character; windows round-headed and without

mullions; doorways moderately recessed and highly decorated with the cable, chevron, and other distinctive ornaments; arcades much employed for decoration, frequently by a con-

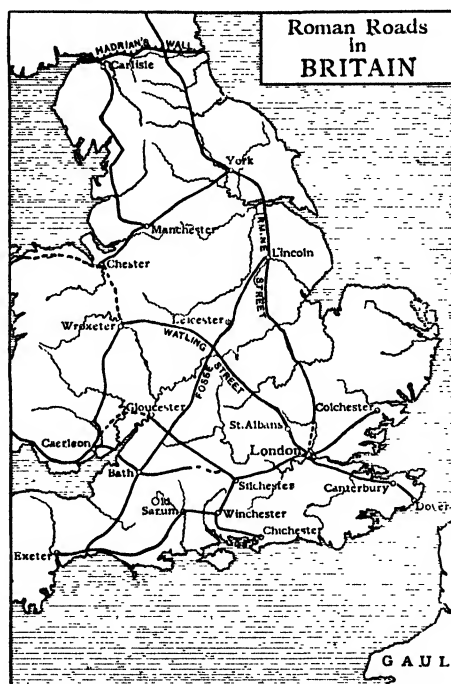


Romanesque Arcade, Canterbury

tinuous series round the upper part of the apse and round the upper parts of transepts also, when the transepts are rounded externally. The principal front is frequently flat and decorated with arcades in successive rows from the apex of the roof till just above the portals, producing a rich effect, as at Pisa Cathedral. See *Architecture*; *Norman Architecture*.

Roman Roads and Walls. The Romans were, from an early period of their history, great road-makers, and the great Appian Way dates from the beginning of the third century B.C. Roman roads were marked by solidity of construction, and many of them have survived to modern times either as actual roadways or as foundations of later roads. The engineers generally followed a straight line, and crossed hills which later road-makers would have avoided. In the later periods of Roman history, roads and ramparts or walls played a large part in the administration and defence of the provinces. In Roman Britain the chief roads led from London to Canterbury and the coast of Kent; to Silchester (near Newbury), Winchester, Gloucester, Bath, and Exeter; to Lichfield and Chester; and to Lincoln, Doncaster, and York. The only great cross-country road connected Lincoln with Exeter, the route passing by Leicester, Cirencester, and Bath. There are also remains of some less important roads. The English road-makers did not follow the Roman models, but Roman methods of road-making long survived in France. In North Britain there was only one great Roman road, from Corbridge on the Tyne, by Newstead, Inveresk, and Cramond, to Abercorn on the Forth, but North Britain was marked by a series of Roman walls or ramparts. The province of South Britain, with its great cities and its excellent means of communication, was liable to inroads from the barbarians of the North, whom the Romans did not attempt to govern, though they made punitive expeditions into their country.

Agricola, who was Governor of Roman Britain from A.D. 78 to 85, built a series of forts between the Firth of Forth and the Firth of Clyde, but this advanced line of defence was abandoned about A.D. 120 by the Emperor Hadrian, who built from the Tyne to the Solway a rampart, believed to have been 17 feet high and 7 feet thick. It was built of blocks of stone, vacant places being filled in with rubble, and at intervals along the line were forts and camps. This was the great Roman Wall; in its original form, as built by Hadrian, it may have been merely a rampart of sods, and the stone blocks may date from the time of the Emperor Severus, who strengthened it about A.D. 210. In the interval an attempt had been made to hold the line originally chosen by Agricola, and about the year 140 a Roman general, Lollius Urbicus, built, between the Forth and Clyde, a rampart, known



as the wall of the Emperor Antoninus Pius, which was held for about forty years. Remains both of Hadrian's Wall, as restored by Severus, and of the wall of Antoninus Pius can still be seen.—**BIBLIOGRAPHY:** F. Haverfield, *The Romanization of Roman Britain*; J. C. Bruce, *The Roman Wall*.

Romans (ro-män), a town of South-Eastern France, in the department of Drôme, on the Isère. It has manufactures of silks, leather, boots, and hats. Pop. 18,000.

Romans, Epistle to the, the most elaborate and, from a doctrinal point of view, the most important composition of St. Paul. It sets forth that the gospel doctrine of justification by faith is a power unto salvation to all men, both Jews and Gentiles. The writer then deplores the rejection of the Jews, and in the practical part admonishes the Romans to exercise the various gifts bestowed upon each in a spirit of love and humility; he especially urges the strong to bear with the weak, and concludes with various salutations and directions. In modern times doubts have been thrown upon the authenticity of the concluding portion of this epistle, some critics regarding the whole of chapter xvi as spurious.

Romanticism and Classicism. The term Romantic is derived from the Romance languages, which reached their highest development in Provence. The literature which grew up in this language consisted generally of tales and ballads, relating the adventures of knights, their deeds of chivalry, and their devotion to the Christian religion.

A reaction, however, set in against this kind of literature after the enthusiasm of the Renaissance. It was a reaction both against poetic feeling and imagination as well as against religious intensity. This period in literature is called the classical. Works written in Latin and Greek, were looked upon as the only correct standards of purity and refinement of taste. But classicism meant not only an imitation of the ancient writers, but also an admiration of the finish of form, an exaltation of reason and intellect, and a repression of imagination and passion. Although, however, all the efforts of classicism were directed towards polished and refined expression and a restraint of emotion and imagination, the classical period in Europe has nevertheless produced literature, both prose and poetry, of a notable order. It covers the ages of Dryden, Pope, and Johnson in Britain, and of Louis XIV in France. Among the writers of the Augustan or classical age in Britain may be reckoned (besides the three literary autocrats, Dryden, Pope, and Johnson), Abraham Cowley, Andrew Marvell, Samuel Butler, Jonathan Swift, Joseph Addison, Sir Richard Steele, Daniel Defoe, Matthew Prior, James Thomson, and Thomas Gray. It should, however, be borne in mind that Ben Jonson and Milton had been to some extent pioneers of classicism. Thus, beginning with the Restoration drama, classicism in Britain culminated with the age of Pope and extended its influence through the age of Johnson. In France the great names of the classical period include those of P. Bayle, Bossuet, Fénelon, La Bruyère, La Fontaine, Boileau, Corneille, Racine, and Molière. Towards the middle of the eighteenth century, however, a revolt against the classic

tradition in art broke out in Western Europe. This movement is known as romanticism. In contradistinction to classicism, it appealed to the emotions instead of the intellect, and gave rise to the Barbizon painters in France and the Pre-Raphaelite school in Britain.

In literature the romantic revolt against classical authority may be said to have begun during the last quarter of the eighteenth century, when a wave of romanticism swept over the Teutonic, Latin, and Slavonic countries. The aim of romanticism was to follow individualistic tendencies and to burst the bonds of convention. Impatient of restraint, formality, and the old order, it represented an awakening to a sense of mystery and a sympathy with nature. Stendhal defined romanticism as "representing progress, liberty, and originality", whilst Walter Pater wrote that "the sense of curiosity added to the desire of beauty, constitutes the romantic temper".

Whilst, however, in France romanticism was really a revolt and a rebellion, in Britain it was merely a revival and a restoration, for the romantic spirit had never wholly and entirely disappeared in this country. It therefore meant a return to the national genius, and a revival of the old tradition expressed in Chaucer, Spenser, and Shakespeare. The movement was consequently not so intense, the transformation not so fundamental, as in France or in Germany. In the latter country the romantic movement was an emancipation from Latin influence and tyranny, and an assertion of German individuality.

In Britain the romantic revolt against the classical spirit was initiated by Thomson, but it actually began with the publication of Percy's *Reliques*, a work which provided inspiration for romantic poetry. A further powerful influence was exercised by Macpherson's pretended translation of Ossian, and the literary forgeries of Chatterton. In 1764 Horace Walpole published his *Castle of Otranto*, and gradually romanticism established its sway. Wordsworth became its high-priest, and it reached its perfection in the work of Scott, Coleridge, Byron, Shelley, and Keats. The romantic revolt was, however, not limited to one country, but affected all Europe. In France it began with Rousseau and his cry of a return to nature, and it may be traced through Chateaubriand, Lamartine, De Musset, and Victor Hugo, whose *Hernani* (1830) was epoch-making. Other romantic authors in France were: Charles Nodier, Théophile Gautier, George Sand, and Balzac. In Germany the movement may be said to have already begun with Lessing, and can be traced through Herder, Schiller, Goethe, the two Schlegels, Schelling, Tieck, Novalis, and Schleiermacher. In Italy

the most notable romantic writers were Manzoni and Leopardi; whilst in Russia Pushkin, Gogol, and Lermontov are the foremost representatives of romanticism.—BIBLIOGRAPHY: G. Brandes, *Main Currents in 19th Century Literature*; C. E. Vaughan, *The Romantic Revolt*; W. H. Crawshaw, *The Making of English Literature*; C. H. Herford, *The Age of Wordsworth*.

Rome (Ital. *Roma*), a province of Italy, co-extensive with Latium. It lies between Tuscany and Campania, is mountainous, and is traversed by the Tiber. It is devoted to agriculture, but contains also the city of Rome. Area, 4664 sq. miles; pop. 1,400,000.

Rome (Lat. *Roma*), the most famous state of ancient times, originally comprising little more than the city of Rome, subsequently an empire embracing a great part of Europe, Northern Africa, and Western Asia. The origin of Rome is generally assigned to the year 753 B.C., at which time a band of Latins, one of the peoples of Central Italy, founded a small town on the left bank of the Tiber, about 15 miles from the sea, the population being afterwards augmented by the addition of Sabines and Etruscans. The weight of tradition places it beyond doubt that in the earliest period the Government of Rome was an elective monarchy, the king being chosen by an assembly of *patres* (fathers) or heads of families who formed the Senate. According to tradition, these kings were seven in number, their names and traditional reigns being as follows: Romulus, 753–716 B.C.; Numa Pompilius, 715–676; Tullus Hostilius, 674–642; Ancus Martius, 642–618; L. Tarquinius Priscus, 618–578; Servius Tullius, 578–534; and Tarquinius Superbus, 534–509. The last three were of Etruscan origin, pointing to a temporary supremacy at least of Etruria over Rome.

From the commencement of Roman history the people are found divided into two classes, the *patricians* or aristocracy (a kind of oligarchy) and the *plebeians* or common people, besides a class called *clients*, immediate dependents of the patricians. All political power was in the hands of the patricians. All matters of importance had to be laid before them in their *comitia curiata* or assembly, in which they voted by divisions called *curiæ*. (See *Comitia*.) From and by them also were elected the members of the Senate or Council of the Elders, as it may be called, which advised the king. By reforms instituted by Servius Tullius the way was at least prepared for altering this state of affairs. He introduced a division of all the people, according to their property, into five *classes*, and these again into *centuries*. With the first or highest class was sometimes reckoned a body called *equites* or horsemen, but these were sometimes regarded as above all the classes. The lowest section of the people,

called *proletarii*, was sometimes reckoned as a sixth class, and sometimes as forming part of the fifth. Thus originated a new assembly, the *comitia centuriata*, which included plebeians as well as patricians, though the latter had the great preponderance. The plebeians got also an assembly of their own with certain limited powers, the *comitia tributa*, in which they met by local divisions called tribes.

The last of the kings, Tarquinius Superbus, by his tyrannical government excited the hatred of all classes, and this was raised to the highest pitch by an act of violence perpetrated by his youngest son Sextus. The people then rose in rebellion, and abolished for ever the kingly government (509 B.C.).

The Republic.—Upon the expulsion of the kings the royal power was entrusted to one man, who held it for a year, and was called *dictator*. Afterwards two yearly officers, called at first *prætors*, afterwards *consuls*, wielded the highest executive power in the state both in civil and military affairs.

Almost all political power still remained with the patricians, however, and for more than 200 years the internal history of Rome is mainly composed of the endeavours of the plebeians to place themselves on an equality with the patricians. In 494 B.C. the plebeians succeeded in securing a measure of justice. Two magistrates called *tribunes* were chosen from the ranks of the plebeians. Their persons were inviolable; and they had the right of protecting every plebeian against injustice on the part of an official. Later they were admitted to the Senate, where they had the right of vetoing resolutions and preventing them from becoming law. Their number was afterwards increased to five, and finally to ten. The tribunes, through ignorance of the laws, which were kept secret by the patricians, were often thwarted in their endeavours to aid the plebeians. The plebs demanded the publication of the laws, and at last the Senate yielded. It was agreed that in place of the regular magistrates ten men (*decemviri*) should be nominated, with unlimited power to govern the state and prepare a code of written laws. These men entered on office in 451 B.C., and in the first year of office they had compiled ten tables of laws, and to these in the second year they added other two tables, making up the famous Laws of the Twelve Tables. But when the second year had elapsed, and the object for which they had been appointed was accomplished, they refused to lay down their office, and were only forced to do so by an insurrection. The immediate occasion of this rising was, according to the well-known story made popular by Macaulay in his lay of Virginia, an act of infamy attempted by one of the ten. After the overthrow of the

decemvirate two chief magistrates were re-appointed, but the title was now changed from *prætors* to *consuls* (449 B.C.). In 444 another change was made by the appointment of military tribunes with consular power (from three to six or even eight in number), who might take the place of the consuls. To this office both classes of the community were eligible, although it was not till 400 B.C. that a plebeian was actually elected. In 443 B.C. a new patrician office, that of *censor*, was created. No plebeian was censor till 351 B.C.

Roman Conquests.—During this period of internal conflict Rome was engaged in defensive wars chiefly with the *Æquians* and *Volscians*, who lived close by. With these wars are connected the legends and traditions of *Coriolanus*, the extermination of the *Fabii*, and the saving of the Roman army by *Cincinnatus*. (See *Coriolanus*; *Fabii*; *Cincinnatus*.) Towards the end of the fifth century B.C., after extending her territory to the south, Rome turned her arms against Etruria in the north. For ten years (405–396) the important city of Veii is said to have been besieged, till in the latter year it was taken by Camillus, and the capture of this city was followed by the submission of all the other towns in the south of Etruria. But just at this point Rome was thrown back again by a total defeat and rout on the banks of the Allia, a small stream about 11 miles north of Rome, and the capture and destruction of the city by the Gauls in 390 B.C. After the Gauls retired with their booty the city was hastily reconstructed, but the destitution and suffering of the people rendered domestic tranquillity impossible. After a struggle, however, the Licinian laws were adopted in 367, the plebeians being now admitted to the consulship, and a fairer distribution of public lands being brought about.

During the period 343–264 Rome was engaged in many important wars, the chief of which were the four Samnite Wars, the great Latin War, the war with the Greek cities of Southern Italy, and the war with Pyrrhus, the invader of Italy from Greece. The chief events of this protracted struggle were the defeat of the Romans by the Samnites under Pontius at the Caudine Forks, and the passing of the Romans under the yoke in acknowledgment of their subjugation (321 B.C.); the defeat of the Samnites, Umbrians, Etruscans, and Gauls at Sentinum (295 B.C.); and the final defeat of Pyrrhus at Beneventum (275 B.C.). In 272 B.C. the city and fortress of Tarentum surrendered to the Romans, and the defeat of the Sallentini in Calabria (266) made the Romans masters of all Italy south of the Rubicon and Macra.

Punic and other Wars.—Rome, having had leisure to conquer Italy, now felt at liberty to

contend for the possession of Sicily, at this time almost entirely under the dominion of the great maritime power of Carthage. An opportunity for interfering in Sicilian affairs was easily found, and in 264 B.C. the first Punic or Carthaginian War began. It lasted for more than twenty years, caused the loss of three large fleets to the Romans, and the defeat of a Roman army under Regulus in Africa; but in 241 a great victory over the Carthaginian fleet caused the latter power to sue for peace. This was finally concluded on the conditions that Carthage gave up Sicily, and paid a great sum as a war indemnity. The larger western part of Sicily became the *first Roman province*; the smaller eastern part continued under the supremacy of the Greek city Syracuse, which was allied to Rome. The sway of Rome was also extended over all the islands which Carthage had possessed in the Mediterranean. About the same time the Romans wrested the Island of Coreyra (Corfu) and some coast towns from the piratical Illyrians. From 226 to 222 B.C. they were engaged in a more difficult war with Gauls inhabiting the Po basin; but the Romans were again successful, and the Gallic territory was reduced to a Roman province under the name of Gallia Cisalpina (Gaul on this side the Alps).

Meanwhile the Carthaginians had been making considerable conquests in Spain, which awakened the alarm and envy of the Romans, and induced them to enter into a defensive alliance with the Greek colony of Saguntum, near the east coast of that country. In 221 B.C. Hannibal, the son of Hamilcar Barca, who had bravely and skillfully maintained the Carthaginian arms in Sicily, and had since founded and in great part established the Carthaginian Empire in Spain, succeeded to the command of the Carthaginian forces. The taking of Saguntum, a city allied to Rome, occasioned the second Punic War, during which Hannibal traversed Gaul, crossed the Alps, and invaded Italy. The war lasted for sixteen years (218–202) B.C.; and was carried on with consummate generalship on the part of Hannibal, who inflicted on the Romans one of the most disastrous defeats they ever sustained, at Cannæ, in 216 B.C. This great man was ill supported by his country, and the war terminated in favour of the Romans through the defeat of Hannibal by P. Cornelius Scipio at Zama, in Africa, in 202 B.C. (See *Hannibal*.) One of the results was that the power of Carthage was broken and Spain practically became a Roman possession. Upper Italy was also again subjugated, and Transpadane Gaul acquired. A third Punic War broke out on slight pretext in 149 B.C., and ended in 146 in the capture of Carthage by Scipio (the younger) after a severe struggle, and the conversion of the Carthaginian territory into the province of Africa.

Philip V of Macedonia had favoured Hannibal, and so gave Rome a pretext to mix in Grecian affairs. The result was that Macedonia was made a Roman province (148 B.C.), while in the same year that Carthage fell Corinth was sacked, and soon after Greece was organized into the province of Achaia. (See *Greece*.) Previously Antiochus the Great of Syria had been defeated by the Romans (190 B.C.) and part of Asia Minor brought into vassalage to Rome. In the east Rome intrigued where she could, and fought when she was compelled, and by disorganizing states made them first her dependencies and then her provinces. In 130 B.C. she received by bequest the dominions of Attalus III of Pergamus (Mysia, Lydia, Caria, and Phrygia), which was formed into the province of Asia.

Measures of the Gracchi.—By this time within Rome strife between different classes again began to be bitter, but it was now not between patricians and plebeians, but between rich and poor. The conquests which had been made, and the lucrative posts which were now to be had, as well as the wide field generally available for money-making, had produced a wealthy privileged class partly consisting of patricians, partly of plebeians, without benefiting the other classes of the citizens. The agrarian laws which formerly protected the people were generally unobserved, great landed estates were accumulated in few hands, and the cultivation of the land by swarms of slaves left war the only occupation of the citizens. Thus vast numbers of the middle class of citizens were reduced to absolute want, and driven from their homes. To remedy this the two Gracchi, Tiberius and Gaius, successively proposed measures for the better distribution of the land, and in general for the relief of the destitute classes. They thus incurred the violent hatred of the nobles or men of position, and both of them lost their lives in the party struggles that ensued (in 133 and 121 B.C. respectively).

Previously to this the Romans had formed an alliance with the Greek colony of Massilia (Marseilles), and in aid of their allies they were twice called in to quell the neighbouring Gallic tribes (first in 154 B.C., and next in 125 B.C.). On the second occasion, after putting down the Gauls (125–123), they kept possession of the conquered country, and made this part of Gaul a Roman province (Provincia Gallia—Provence). The next war was in Africa, with Jugurtha, who had usurped the throne of Numidia, and against whom the assistance of Rome had been asked. It was brought to an end by Gaius Marius, who had risen from an obscure rank to the consulship (104 B.C.). Marius also repelled invasions of the province of Gaul by the Cimbri and Teutones in 102–101 B.C. A serious war, almost of the nature of a civil war, followed with the

Roman allies in Italy, who rose in 90 B.C. to demand the right of equal citizenship with the people of Rome. This war, known as the Social War, lasted for two years (90–88 B.C.), and ended in the victory of the Romans, who, however, found it advisable to concede the franchise to the Italian tribes to prevent another rising.

The End of the Republic.—The war had been concluded by Sulla, between whom and Marius great rivalry prevailed; and now sprang up the first Roman civil war, a struggle between the party of Marius (the people) and that of Sulla (the nobles). Sulla, the consul for 88, was on the point of starting for Asia to attack Mithridates, King of Pontus, a war that promised both glory and treasure. Marius was eager for the same command, and through intrigue on his behalf the populace deprived Sulla of the chief command and gave it to Marius. Thereupon Sulla marched on Rome with his legions, forced Marius to flee to Africa, and then proceeded to the Mithridatic War. In his absence Marius returned, wreaked a bloody vengeance on the partisans of his rival, and died after being appointed consul for the seventh time (86 B.C.). Three years later Sulla came back from Asia, having brought the Mithridatic War to a satisfactory conclusion, and now felt himself at liberty to take his revenge on the Marian party for the atrocities it had been guilty of towards his own party in his absence; and he took it in full measure. Four thousand of his opponents he caused to be massacred in the circus in one day; and then got rid of all the chief men of the democratic party by proscription. He was now appointed dictator for an unlimited term (81 B.C.), and as such passed a series of measures the general object of which was to restore to the constitution its former aristocratic or oligarchical character. In the beginning of 79 B.C. Sulla retired into private life, and he died the year following.

The man who now came most prominently before the public eye was Pompey, one of Sulla's generals. His first important achievement was the subjugation of the remnant of the democratic or Marian party that had gathered round Sertorius in Spain (76–72 B.C.). On his return to Italy he extinguished all that remained of an insurrection of slaves, already crushed by Crassus (71), and in 70 B.C. was consul along with Crassus. In 67 B.C. he drove the pirates from the Mediterranean, and afterwards reduced Cilicia, which he made into a Roman province. He was then appointed to continue the war that had been renewed against Mithridates, King of Pontus, whom he finally subdued, forming part of his dominions in Asia Minor into a Roman province, and distributing the rest among kings who were the vassals of Rome. In 64 B.C. Pompey put an end to the dynasty of the Seleucidæ in Syria, and

converted their kingdom into a province, and in 63 B.C. advanced southwards into Judæa, which he made tributary to Rome. All these arrangements were made by him of his own authority. In the very year in which they were completed a member of the aristocratic party, the great orator Cicero, had earned great distinction by detecting and frustrating the Catilinarian conspiracy. (See *Catiline*.)

Only three years after these events (60 B.C.) a union took place at Rome of great importance in the history immediately subsequent. Gaius Julius Cæsar, a man of aristocratic family who had attached himself to the democratic party and had become very popular, joined Pompey and Crassus in what is called the *first triumvirate*, and practically the three took the government of Rome into their own hands. On the part of Cæsar, who was now elected consul, this was the first step in a career which culminated in the overthrow of the republic, and his own elevation to the position of sovereign of the empire. After the death of Crassus (53 B.C.) came the struggle for supreme power between Cæsar and Pompey. Cæsar had gained great glory by the conquest of Gaul, but now at Pompey's instigation was called on to resign his command and disband his army. Upon this he entered Italy, drove Pompey into Greece, and the short civil war of 49–48 B.C., and the great battle of Pharsalia in the latter year, decided the struggle in Cæsar's favour. Pompey's army was utterly routed; he himself was compelled to flee, and having gone to Egypt was there murdered. In a short time Cæsar utterly subdued the remains of the Pompeian party, and became virtually king in Rome. Cæsar was assassinated in 44 B.C., and the main result of the conspiracy by which he fell was that the first place in Rome had again to be contested. The competitors this time were Octavianus, the grand-nephew and adopted son of Cæsar, then only nineteen, and Mark Antony, one of Cæsar's generals. In 43 B.C. these two formed with Lepidus what is known as the *second triumvirate*; and after avenging the death of Cæsar and putting an end to the republican party in the battle of Philippi (42), Octavian and Antony, casting off Lepidus, who was a weakling, divided the empire between them, the former taking Rome and the West, and the latter the East. In ten years war broke out between the two, and in the naval battle of Actium (31 B.C.) Antony was defeated, and the whole Roman world lay at the feet of the conqueror, Egypt being also now incorporated. Not long after this Octavian received the title of Augustus, the name by which he is known in history as the first of the Roman emperors.

The Roman Empire.—In his administration of the empire Augustus acted with great judgment,

ostensibly adhering to most of the republican forms of government, though he contrived in course of time to obtain for himself all the offices of highest authority. The reign of Augustus is chiefly remarkable as the golden age of Roman literature, but it was a reign also of conquest and territorial acquisition. Before the annexation of Egypt Pannonia had been added to the Roman dominions (35 B.C.), and by the subsequent conquest of Mæsia, Noricum, Rætia, and Vindelicia, the Roman frontier was extended to the Danube along its whole course. Gaul and Spain also were now finally and completely subdued. The empire of Augustus thus stretched from the Atlantic to the Euphrates, and from the Rhine and the Danube to the deserts of Africa. This emperor died in A.D. 14. His reign is above all memorable for the birth of Jesus Christ (q.v.).

Augustus was followed by a series of emperors forming, when he and Julius Cæsar are included, the sovereigns known as the *Twelve Cæsars*. The names of his successors and the dates of their deaths are: Tiberius, A.D. 37; Caligula, 41; Claudius, 54; Nero, 68; Galba, 69; Otho, 69; Vitellius, 69; Vespasian, 79; Titus, 81; and Domitian, 96. Most of these were sensual and bloodthirsty tyrants, Vespasian and his son Titus being the chief exceptions. Vespasian's reign was noted for the taking and destruction of Jerusalem; that of Titus for the destruction of the cities of Pompeii and Herculaneum by an eruption of Vesuvius (A.D. 79). After Titus his tyrannical brother Domitian reigned till his death by assassination in A.D. 96, when an aged senator, Nerva, was proclaimed as his successor.

Nerva's reign was short (96–98) but beneficent, and he was followed by four emperors, Trajan, Hadrian, Antoninus Pius, and Marcus Aurelius, who together reigned for more than eighty years, and under whom the countries making up the Roman Empire enjoyed in common more good government, peace, and prosperity than ever before or after. Trajan (98–117) was a warlike prince, and added several provinces to the Roman Empire. Hadrian (117–138), the adopted son of Trajan, devoted himself entirely to the internal affairs of his empire. It was in his reign that the southern Roman wall, or rampart between the Tyne and the Solway Firth, was erected. Antoninus Pius (138–161) was likewise the adopted son of his predecessor. In his reign the northern wall in Britain, between the Forth and Clyde, was constructed. The next emperor, Marcus Aurelius (161–180), was both the son-in-law and the adopted son of Antoninus Pius. He combined the qualities of a philosopher with those of an able and energetic ruler.

Commodus (180–193), the son and successor of Aurelius, inherited none of his father's good

qualities, and his reign, from which Gibbon dates the decline of the Roman Empire, presents a complete contrast to those of the five preceding emperors. During his reign an era of military despotism ensued. The praetorian guard (the imperial body-guard) became virtually the real sovereigns, while the armies of the provinces declared for their favourite officers, and the throne became the stake of battle. In the long

empire was again consolidated under Aurelian (270-275), who subdued all the other claimants to the imperial dignity, and put an end to the Kingdom of Palmyra, which was governed by the heroic Zenobia.

The reign of Diocletian (284-305) is remarkable as affording the first example of that division of the empire which ultimately led to the formation of the empire of the West and the empire



list of emperors who succeeded may be noted Septimius Severus, who reigned from 193 to 211, during which time he restored the empire to its former prestige. He reconquered Mesopotamia from the Parthians, but in Britain he confined the Roman province to the limit of Hadrian's Wall, which he restored. He died at York. Alexander Severus, who reigned from 222 till 235, was also an able ruler, and was also the first emperor who openly extended his protection to the Christians. His death was followed by a period of the greatest confusion, in which numerous emperors, sometimes elected by the Senate, sometimes by the soldiers, followed one another at short intervals, or claimed the empire simultaneously. This period is known as the era of the Thirty Tyrants. Meanwhile the empire was ravaged on the east by the Persians, while the German tribes and confederations (Goths, Franks, Alemanni) invaded it on the north. The

of the East. Finding the number of the barbarian violators of the Roman frontier too great for him, he adopted as joint-emperor Maximian; and in 292 each of these associated with himself another, to whom the title of Caesar was allowed. Diocletian took Galerius, and Maximian his son-in-law Constantius Chlorus. These four now divided the empire between them. Diocletian assumed the government of the East with Thrace, allotting to Galerius the Illyrian provinces; Maximian assumed Italy, Africa, and the islands of the Mediterranean, and left to Constantius Spain, Gaul, and Britain. This arrangement temporarily worked well, but in 323 Constantine, the son of Constantius, was left sole master of the empire.

Ever since the time of Augustus and Tiberius, Christianity had been spreading in the Roman Empire, notwithstanding terrible persecutions. The number of churches and congregations had increased in every city; the old religion (see

below) had died out, and very few believed in it; so at last Constantine judged it wise to make the Christian religion the religion of the empire. He also removed the seat of government from Rome to Byzantium, which was hence called Constantinople (330), and completely reorganized the imperial administration. Constantine died in 337. The empire was left among his three sons, of whom Constantius became sole ruler in 353.

The next emperor, Julian the Apostate, sought to restore the old religion, but in vain. He was an able ruler, but fell in battle against the Persians in 363. He was succeeded by Jovian, who reigned less than one year; and after his death (364) the empire was again divided, Valens (364-378) obtaining the eastern portion, and Valentinian (364-375) the western. From this division, which took place in 364, the final separation of the eastern and western empires is often dated. In the reigns of Valens and Valentinian great hordes of Huns streamed into Europe from the steppes of Central Asia. After subduing the Eastern Goths (Ostrogoths) they attacked those of the west (Visigoths); but these, since they had already been converted to Christianity, were allowed by Valens to cross from the left to the right bank of the Danube, and settle in Mœsia. In their new homes they found themselves exposed to the oppression and rapacity of the Roman governors, and when they could no longer brook such treatment they rose in rebellion, and defeated Valens in the sanguinary battle of Adrianople, in the flight from which the emperor lost his life (378). His son Gratianus created the heathen Theodosius co-regent, and entrusted him with the administration of the East. Theodosius became a Christian, fought successfully against the Western Goths, but was obliged to accept them as allies in their abodes in Mœsia and Thrace. In 394 the whole empire was reunited for the last time under Theodosius. After his death (395) the empire was divided between his two sons, Honorius and Arcadius, and the eastern and western sections became permanent divisions of the empire, the latter being now under Honorius. For the further history of the empire of the East, see *Byzantine Empire*.

In 402 Alaric, King of the Visigoths who were settled on the south of the Danube, was incited to invade Italy, but he was soon forced to withdraw on account of the losses he suffered in battle (408). Scarcely had these enemies retreated when great hosts of heathen Teutonic tribes, Vandals, Burgundians, Suevi, and others, made an irruption into Italy on the north; but these also were overcome by Stilicho, the guardian of the youthful Emperor Honorius, in the battle of Fiesule (or Florence), and compelled to withdraw (406). The Burgundians now settled in part of Gaul, while the Vandals and Suevi crossed

the Pyrenees into Spain. In 408 Alaric marched into Italy, advanced up to the walls of Rome, and ultimately took the city by storm (410). Shortly after Alaric died, and his brother-in-law Athaulf (Adolphus) concluded a treaty with Honorius, and retired into Gaul, where the Visigoths founded in the south-west a kingdom that extended originally from the Garonne to the Elbro (412). About this time also the Romans practically surrendered Britain, by withdrawing their forces from it, and thus leaving it a prey to Teutonic pirates and northern savages. In 429 the Vandals wrested the province of Africa from the empire and set up a Vandalic kingdom in its place. In 452 the Huns left their settlements in immense numbers under their king Attila, destroyed Aquileia, took Milan, Pavia, Verona, and Padua by storm, laid waste the fruitful valley of the Po, and were already advancing on Rome when the Roman bishop, Leo I, succeeded in inducing them to conclude a peace with Valentinian and withdraw. Soon after their leader Attila died (453), and after that the Huns were no longer formidable. Two years after the death of Attila, Eudoxia, the widow of Valentinian, the successor of Honorius, invited the assistance of the Vandals from Africa, who under their leader Genseric proceeded to Rome, which they took and afterwards plundered for fourteen days, showing so little regard for the works of art it contained as to give to the word vandalism the sense it still expresses (455). They then returned to Africa with their booty and prisoners. After the withdrawal of the Vandals, Avitus, a Gaul, was installed emperor. Under him the Suevian Ricimer, the commander of the foreign mercenaries at Rome, attained such influence as to be able to set up and depose emperors at his pleasure. The last of the so-called Roman emperors was Romulus Augustulus (A.D. 475-476). His election had been secured through the aid of the German troops in the pay of Rome, and these demanded as a reward a third part of the soil of Italy. When this demand was refused, Odoacer, one of the boldest of their leaders, deposed Romulus, to whom he allowed a residence in Lower Italy with a pension, and assumed to himself the title of King of Italy, thus putting an end to the Western Roman Empire, A.D. 476. (See *Italy*.)

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Language.—The language of the Romans was Latin, a language originally spoken in the plain lying south of the Tiber. Like the other ancient Italian dialects (Oscan, Umbrian, &c.), it is a branch of the Indo-European or Aryan family of languages, and is more closely allied to the Greek than to any other member of the family. At first spoken in only a small part of Italy, it spread with the increase of Roman power, till at the advent of Christ it was used throughout the whole empire. The Latin language is one of the highly inflected languages, in this resembling Greek or Sanskrit; but as compared with the former it is a less perfect vehicle of expression, being less flexible, less adapted for forming compound words, and altogether less artistic in character. The earliest stage of Latin is known almost wholly from inscriptions. During the period of its literary development many changes took place in the vocabulary, inflection, word formation, and syntax. In particular, considerable additions to the vocabulary were made from the Greek. At the same time the language gained in refinement and regularity, while it preserved all its peculiar force and majesty. The most perfect stage of Latin is that represented by Cicero, Horace, and Virgil in the first century B.C.; and the classical period of the Latin language ends in the second century A.D. The decline may be said to date from the time of Hadrian (117–138). In the third century the deterioration of the language proceeded at a very rapid rate. In the fourth and fifth centuries the popular speech, no longer restrained by the influence of a more cultivated language, began to experience that series of transmutations and changes which formed the transition to the Romance languages. Latin, however, still remained, through the influence of the Church and the law, the literary language till far on in the Middle Ages; but it was a Latin largely intermixed with Celtic, Teutonic, and other elements, and is now usually called Late or Low Latin. The study of Latin is of great assistance in acquiring an accurate knowledge of English, as a great part of the English vocabulary is of Latin origin, being either taken from the French or from classical Latin directly.

Literature.—The history of Roman literature naturally divides itself into three periods of Growth, Prime, and Decline. The first period extends from about 250 B.C. to about 80 B.C. The second period ranges from 80 B.C. to the death of Augustus in A.D. 14, and includes the greater part of the Roman literature usually studied in schools and colleges. The period of decline then followed. Poetry in this language, as in all others, preceded prose. The oldest forms of Latin poetry were the Fescennine verses, which were poems of a jocular and satirical

nature sung at marriages and country festivals; satires or improvised dialogues of miscellaneous contents and various form; and the *Atellanæ fabulæ*, a species of grotesque comedy supposed to resemble the modern Punchinello. The first known writer was Livius Andronicus, a Greek freedman taken prisoner at Tarentum (272 B.C.) and afterwards emancipated, who about 240 B.C. exhibited at Rome a drama translated from the Greek, and subsequently brought out a translation of the *Odyssey*. He was followed by Nævius, who wrote an historical poem on the first Punic War, besides dramas; by the two tragic writers Pacuvius and Accius or Attius; and by Ennius, author of eighteen books of metrical annals of Rome and of numerous tragedies, and regarded by the Romans themselves as the founder of Roman poetry. Mere fragments of these early works alone remain. The founder of Roman comedy was Plautus (254–184 B.C.), who was surpassed for force of comic humour by none of his successors. Next followed Cæcilius; and then Terence (195–159 B.C.), a successful imitator and often mere translator of the Greek dramatist Menander and others, and, although an African by birth, remarkable for the purity and excellence of his Latinity. These three comic writers took the New Comedy of the Greeks as their model (*Comædia palliata*); and we still possess a number of plays by Plautus and Terence. On the other hand, Afranius, with a few others, introduced Roman manners upon the stage (*Comædia togata*). Lucilius (180–103 B.C.) was the originator of the Roman poetical satire, the only kind of literary composition among the Romans which was of native origin. Lucretius (98–55 B.C.), a writer full of strength and originality, has left us a philosophical poem inculcating the system of Epicurus, in six books, entitled *De Rerum Natura*. Catullus (84–54 B.C.) was without a peer in lyric poetry, in elegy, and in epigrams. With the age of Augustus a new spirit appeared in Roman literature. The first of the Augustan poets is Virgil (70–19 B.C.), the greatest of the epic poets of Rome, author of eclogues or pastoral poems; the *Georgics*, a didactic poem on agriculture, the most finished of his works; besides the long epic poem entitled the *Æneid*. Contemporary with him was Horace (65–8 B.C.), the most finished of lyric poets, and also eminent in satire. In the Augustan age Propertius and Tibullus are the principal elegiac poets. Along with these flourished Ovid (43 B.C. to A.D. 18), a prolific and sometimes exquisite but too facile a poet. During the age of Augustus the writing of tragedies appears to have been a fashionable amusement, but the Romans attained no eminence in this branch.

After the death of Augustus the department of poetry in which greatest excellence was reached

was satire, and the most distinguished satirists were Persius, and after him Juvenal (flourished about A.D. 100), both of whom expressed, with unrestrained severity, their indignation at the corruption of the age. In Lucan (A.D. 38–65), who wrote the *Pharsalia*, an historical epic on the civil war between Cæsar and Pompey; and Statius (flourished about A.D. 85), who wrote the *Thebaid*, we find a poetic coldness which vainly endeavours to kindle itself by the fire of rhetoric. In the epigrams of Martial (about A.D. 43–104) the whole social life of the times is mirrored with attractive clearness. Valerius Flaccus (about A.D. 70–80), who described the Argonautic expedition in verse, endeavoured to shine by his learning rather than by his originality and freshness of colouring. Silius Italicus (A.D. 25–100), who selected the second Punic War as the subject of an heroic poem, is merely an historian employing verse instead of prose. To this age belong the ten tragedies under the name of L. Annæus Seneca, the rhetorician. After a long period of poetic lifelessness Claudian (flourished about 400) wrote poems inspired with no little of the spirit and grace of the earlier literature.

In the Roman prose literature, eloquence, history, philosophy, and jurisprudence are the principal departments. Prose composition really began with Cato the Censor (234 B.C.), whose work on agriculture, *De Re Rustica*, is still extant. Among the great Roman prose writers the first place belongs to Cicero (106–43 B.C.), whose orations, philosophical and other treatises, letters, &c., are very numerous. Varro's *Antiquities*; Cæsar's *Commentaries*; the lives of Cornelius Nepos, probably an abridgment of a larger work; and the works of Sallust, are among the more important historical productions down to the Augustan period. Livy the historian (59 B.C. to A.D. 17), author of a voluminous history of Rome, is by far the chief representative of Augustan prose. Under Tiberius we have the inferior historian Velleius Paterculus, the anecdotist Valerius Maximus, and Cornelius Celsus, who has left a valuable treatise on medicine. The most important figure of the period of Nero was Petronius, whose *Satiricon*, a Menippean satire, is a remarkable work; another of importance was Seneca the philosopher, put to death by his former pupil A.D. 65. His chief works are twelve books of philosophical 'dialogues', two books on clemency addressed to Nero, seven on investigations of nature, and twenty-two books of moral letters. Quintus Curtius compiled a history of Alexander the Great, and a contemporary writer, Columella (about A.D. 50), a treatise on agriculture. The leading prose writers of the next period were Pliny the elder, whose *Natural History* is still extant (A.D. 23–79), a lengthy history and minor treatises being lost; Quintilian

(A.D. 35–118), who wrote the *Institutes of Oratory*; and Sextus Julius Frontinus, who has left us treatises on aqueducts and on military devices. In the reigns of Nerva, Trajan, and Hadrian we have two great prose writers—Cornelius Tacitus (about A.D. 54–119) and Pliny the younger (A.D. 61–115). The former produced a *Dialogue on Orators*, a life of his father-in-law Agricola, a work on Germany, and two works on Roman history—the *Histories* and the *Annals*. The latter, giving the history of the period between the death of Augustus and the death of Nero, is one of the greatest works of the kind in any literature, but unfortunately only a part of it is in existence. Pliny the younger has left ten books of *Epistles*, and a panegyric in honour of Trajan. C. Suetonius, secretary to Trajan, has left lives of the twelve Cæsars; Cornelius Fronto, the tutor to Marcus Aurelius, a collection of letters, discovered only early in the nineteenth century; and with the *Attic Nights* of Aulus Gellius (second century)—a literary, grammatical, and antiquarian miscellany—the classic Roman prose writers come to a close.—BIBLIOGRAPHY: J. W. Mackail, *Latin Literature*; J. Wight Duff, *A Literary History of Rome*; W. Y. Sellar, *Roman Poets of the Republic*, and *Roman Poets of the Augustan Age*; R. Y. Tyrrell, *Lectures on Latin Poetry*; H. J. G. Patin, *Études sur la poésie latine*; M. L. A. G. Boissier, *Cicéron et ses amis*, and *L'Opposition sous les Césars*; J. E. B. Mayor, *Bibliographical Clue to Latin Literature*.

Religion of Ancient Rome.—The ancient religion of the Romans was quite distinct from that of Greece. Though Greek and Etruscan elements were early imported into it, it was, in fact, a common inheritance of the Italians. Towards the end of the republic the theology of Greece was imported into the literature, and to some extent into the State religion. Later on all forms were tolerated. The Roman religion was a polytheism less numerical in deities and with less of the human element in them than that of Greece. The chief deities were Jupiter, the father of gods and men; his wife Juno, the goddess of maternity; Minerva, the goddess of intellect; Mars and Bellona, god and goddess of war; Vesta, the patron of the State, the goddess of the national hearth where the sacred fire was kept burning; Saturnus and Ceres, the god and goddess of agriculture; Ops, the goddess of the harvest and of wealth; Hercules, god of gain, who also presided over contracts; Mercury, the god of traffic; and Neptunus, god of the sea. Venus was originally a goddess of agriculture, but was early identified with the Greek goddess of love, Aphrodite. There was also a host of lesser deities presiding over private and public affairs; domestic gods, the Lares and Penates, &c. The worship consisted of ceremonies, offer-

ings, prayers, sacrifices, games, &c., to secure the favour, avert the anger, or ascertain the intentions of the gods. In private life the ceremonies were performed in the family; in matters concerning the whole community, by the State. The highest religious power in the State was the *College of Pontifices*, which had control of the calendar, and decided upon the action made necessary by the auguries. The chief of this institution was the *pontifex maximus*. The members of the *College of Augurs* consulted the will of the gods as revealed in omens. The *College of Fetiales* conducted treaties, acted as heralds, and generally superintended the relations between Rome and other States. The officiating priests included the *Flamines*, who presided in the various temples; the *Salii*, or dancing priests of Mars; the *Vestal Virgins*, who had charge of the sacred fire of Vesta; the *Luperci*, sacred to Pan, the god of the country; the *Fratres Arvales*, who had charge of boundaries, the division of lands, &c. In addition to their other duties, the priests had charge of conducting the various public games, &c.—**BIBLIOGRAPHY:** W. W. Fowler, *Religious Experience of the Roman People, from the Earliest Time to the Age of Augustus*; T. R. Glover, *Conflict of Religions in the Early Roman Empire*.

Rome, the capital of Italy, as formerly of the Roman Empire, Republic, and Kingdom, the seat of the Papacy, and long the religious centre of western Christendom, is one of the most ancient and interesting cities of the world. It stands on both sides of the Tiber, about 17 miles from the sea, the river here having a general direction from north to south, but making two nearly equal bends, the upper of which encloses a large alluvial flat, little raised above the level of the stream, and well known by the ancient name of *Campus Martius*. A large part of the modern city stands on this flat, but the ancient city lay mostly to the east and south-east of this, occupying a series of eminences of small elevation known as the Seven Hills of Rome (the Capitoline, the Palatine, the Aventine, the Quirinal, the Viminal, the Esquiline, and the Cælian Hill), while a small portion stood on the other side of the river, embracing an eighth hill (*Janiculum*).

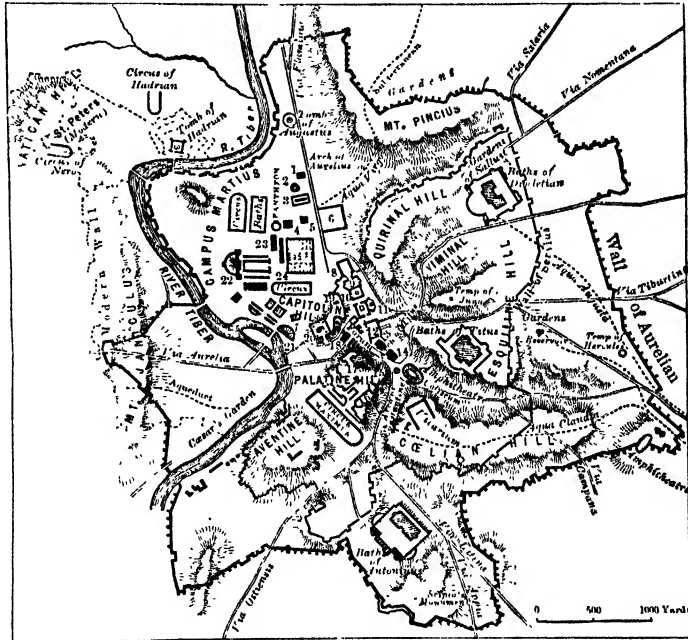
Ancient Rome. Topography, &c.—The streets of ancient Rome were crooked and narrow, the city having been rebuilt, after its destruction by the Gauls in 390 B.C., with great haste and without regard to regularity. The dwelling-houses were often very high, those of the poorer classes being in flats, as in modern Continental towns. It was greatly improved by Augustus, who extended the limits of the city and embellished it with works of splendour. The *Campus Martius* during his reign was gradually covered with public buildings, temples, porticoes, theatres,

&c. The general character of the city, however, remained much the same till after the fire that took place in Nero's reign, when the new streets were made both wide and straight. In the reign of Augustus the population is believed to have amounted to about 1,300,000, and in that of Trajan was not far short of 2,000,000. Rome is said to have been surrounded by walls at three different times. The first of these was ascribed to Romulus, and enclosed only the original city on the Palatine. The second wall, attributed to Servius Tullius, was 7 miles in circuit, and embraced all the hills that gave to Rome the name of the City of Seven Hills. The third wall is known as that of Aurelian, because it was begun and in great part finished by the emperor of that name. It mostly coincides with the wall that still bounds the city on the left or east bank of the Tiber; but on the right or west bank, the wall of Aurelian only embraced the summit of the *Janiculum* and a district between it and the river, whereas the more modern wall on that side (that of Urban VIII) embraces also the Vatican Hill. The wall of Aurelian was about 11 miles in length, that of modern Rome 14 miles. Ancient Rome had eight or nine bridges across the Tiber, of which three still stand. The open spaces in ancient Rome, of which there was a great number, were distinguished into *campi*, areas covered with grass; *fora*, which were paved; and *areae*, a term applied to open spaces generally, and hence to all those which were neither *campi* nor *fora*, such as the squares in front of palaces and temples. Of the *campi* the most celebrated was the *Campus Martius* already mentioned, and after it the *Campus Esquilinus* on the east of the city. Among the latter the *Forum Romanum*, which lay north-west and south-east, between the Capitoline and Palatine Hills; and the *Forum of Trajan*, between the Capitoline and Quirinal, are the most worthy of mention. The first was the most famous and the second the most splendid of them all. The great central street of the city was the *Via Sacra* (Sacred Way), which began in the space between the Esquiline and Cælian Hills, proceeded thence first south-west, then west, then north-west, skirting the north-east slope of the Palatine, and passing along the north side of the Forum, and terminated at the base of the Capitoline. The two principal roads leading out of Rome were the *Via Flaminia* (Flaminian Way) or great north road, and the *Via Appia* (Appian Way) or great south road.

Ancient Buildings.—Ancient Rome was adorned with a vast number of splendid buildings, including temples, palaces, public halls, theatres, amphitheatres, baths, porticoes, monuments, &c., of many of which we can now form only a very imperfect idea. The oldest and most

sacred temple was that of Jupiter Capitolinus, on the Capitoline Hill. The Pantheon, a temple of various gods (now church of S. Maria Rotonda), is still in excellent preservation. (See *Pantheon*.) Other temples were the Temple of Apollo, which Augustus built of white marble, on the Palatine, containing a splendid library; the Temple of Minerva, which Pompey built in the Campus Martius, and which Augustus covered with bronze; the Temple of Peace, once the richest and most beautiful temple in Rome, built by Vespasian, in the Via Sacra, which contained the treasures of the Temple of Jerusalem, a splendid library, and other curiosities, but was burned under the reign of Commodus; the Temple of the Sun, which Aurelian erected to the east of the Quirinal; and the magnificent Temple of Venus, which Cæsar caused to be built to her as the origin of his family. The principal palace of ancient Rome was the *Palatium* or imperial palace, on the Palatine Hill, a private dwelling-house enlarged and adopted as the imperial residence by Augustus. The theatres of Pompey, Cornelius Balbus, and Marcellus were the most celebrated. Of the Theatre of Marcellus, completed 13 B.C., a portion still remains. The most magnificent of the amphitheatres was that of Titus, completed A.D. 80, now known as the Coliseum or Colosseum (q.v.). The principal of the circuses was the *Circus Maximus* (see *Circus*). The porticoes or colonnades, which were public places used for recreation or for the transaction of business, were numerous in the ancient city, as were also the basilicas or public halls. (See *Basilica*.) Among them may be noticed the splendid Basilica Julia, commenced by Cæsar and completed by Augustus; and the Basilica Porcia, which was built by Cato the censor. The public baths or *thermæ* in Rome were also very numerous. The largest were the *Thermæ* of Titus, part of the substructure of which may still be seen on the Esquiline Hill; the *Thermæ* of Caracalla, even larger, extensive remains of which still exist in the south-east of the city;

and the *Thermæ* of Diocletian, the largest and most magnificent of all, part of which is converted into a church. Of the triumphal arches the most celebrated are those of Titus (A.D. 81), Severus (A.D. 203), and that of Constantine (A.D. 311), all in or near the Forum and all well-preserved structures; that of Drusus (8 B.C.) in the Appian Way, much mutilated; that of Gallienus (A.D. 262) on the Esquiline Hill, in a debased style of architecture. Among the



Plan of Ancient Rome

- 1, Temple of Aurelius. 2, Amphitheatre. 3, Hall of Neptune. 4, Isium and Serapium. 5, Temple of Minerva. 6, Campus Agrippæ. 7, Temple of Apollo. 8, Temple of Trajan. 9, Basilica Ulpia. 10, Forum of Trajan. 11, Forum of Augustus. 12, Forum of Vespasian. 13, Basilica of Constantine. 14, Temple of Rome. 15, House of Nero. 16, House of Domitian. 17, House of Augustus. 18, Hall of Julia—Law Court. 19, Asylum. 20, Capitol. 21, Theatre of Marcellus. 22, Theatre of Pompey. 23, Diribitorium. 24, Septa Julia.

columns the most beautiful was Trajan's Pillar in the Forum of Trajan, 117 feet in height, still standing. The bas-reliefs with which it is enriched, extending in spiral fashion from base to summit, represent the exploits of Trajan, and contain about 2500 half and whole human figures. A flight of stairs within the pillar leads to the top. The most celebrated of the ancient sewers is the *Cloaca Maxima*, ascribed to Tarquinius Priscus, a most substantial structure, the outlet of which is still to be seen. Some of the Roman aqueducts brought water from a distance of upwards of 60 miles. Among others, the *Acqua Paola*, the *Acqua Trajana*, and the *Acqua Marzia*

still remain, and contribute to the supply of the city, and also its numerous important ornamental fountains. Among the magnificent sepulchral monuments, the chief were the mausoleum of Augustus in the Campus Martius; and that of Hadrian, on the west bank of the Tiber, now the fortress of modern Rome, and known as the Castle of St. Angelo. See *Catacombs*.

Modern Rome. General Features.—It was not till the seventeenth century that the modern city was extended on the right bank, by a wall built under the pontificates of Urban VIII (1623–44) and Innocent X (1644–55), and enclosing both the Janiculum and the Vatican Hills. Since Rome became the capital of united Italy great changes have taken place in the appearance of the city, many miles of new streets being built, and much done in the way of paving, drainage, and other improvements. It has thus lost much of its ancient picturesque appearance, and has acquired the look of a great modern city with wide straight streets of uniform-looking tenements having little distinctive character. The centralization of government upon Rome has led to a very rapid expansion of the city upon its outer boundaries, and the rapid appearance of new quarters and districts has necessitated the extension of existing thoroughfares and the building of entirely new streets. Extensive excavations have revealed the remains of many of the grandest monuments of ancient Rome, notably the whole of the Forum Romanum and the Via Sacra, the remains of the Temples of Saturn and of Castor and Pollux, the Temples of Vespasian, of Antoninus and Faustina, the Temple of Vesta, &c. A great number of villas and palaces and countless works of art have been brought to light. A vast scheme of river embankment has been carried out to prevent the lower-lying parts of the city from being flooded as in former times.

Churches; Institutions.—As the centre of Christendom for many hundreds of years, Rome is naturally rich in churches, and in the treasures of Christian art. The cathedral of St. Peter (see *Cathedral*) is the largest church in the world. See also *Lateran*. The university was founded in 1303, and is attended by about 5000 students. The Accademia di San Luca, for the promotion of the fine arts, was founded in 1577. Connected

with it are a picture gallery and art schools. The Accademia dei Lincei, founded in 1603 by Galilei and his contemporaries, is the oldest and most important scientific society in Italy. There are several important libraries and museums. The principal hospital, Spirito Santo, is a richly endowed institution.

Trade and Manufactures.—The external trade is unimportant, and is carried on chiefly by rail, the Tiber being navigated only by small craft. There are railway lines connecting with the general system of Italy; and steamers run from Civita Vecchia and Fiumicino to Naples, Leghorn, Genoa, &c. There are tramways. The chief manufactures are woollen and silk goods, artificial flowers, earthenware, jewellery, musical strings, mosaics, casts, and various *objets d'art*.

History.—The ancient history of Rome has already been given in the preceding article. From the downfall of the empire its history is mainly identified with that of the Papacy. (See *Papacy; Papal States; Italy*.) An important event in its history is its capture and sack by the troops of the Constable of Bourbon in 1527. In 1798 Rome was occupied by the French, who sacked the palaces, churches, &c. Pope Pius VI was taken prisoner to France, where he soon afterwards died, and a Roman republic was set up. In 1848 Pope Pius IX was driven from Rome, and another Roman republic formed under Mazzini and Garibaldi. A French army was sent to the Pope's assistance, and after a determined resistance Rome was captured by the French in July, 1849, and the Pope returned and resumed his power under the protection of French bayonets (April, 1850). The rule of the Pope continued till Oct., 1870, when Rome was occupied by the Italian troops on the downfall of the French Empire, and in June, 1871, the 'Eternal City' became the capital of united Italy. The king took up his residence in the Quirinal; and to accommodate the legislature and various public departments numerous conventual establishments were expropriated. Pop. (1881), 276,463; (1901), 462,783; (1915), 590,960. · BIBLIOGRAPHY: J. H. Middleton, *The Remains of Ancient Rome*; J. Dennie, *Rome of To-day and Yesterday*; St. Clair Baddeley, *Rome and its Story*; Norwood Young, *Story of Rome* (Mediæval Towns Series).

